Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

SHOUT
SHARE
IT

BULLETIN NO. 20—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.

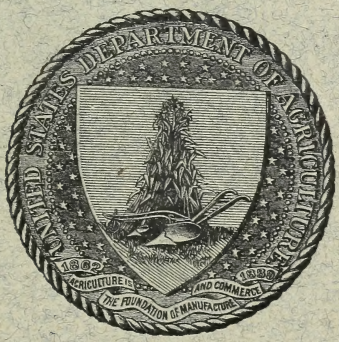
PROCEEDINGS

OF THE

ELEVENTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

DIVISION OF ENTOMOLOGY.

Entomologist: L. O. Howard.
First Assistant Entomologist: C. L. Marlatt.
Assist. Entomologists: Th. Pergande, F. H. Chittenden, Frank Benton.
Investigators: E. A. Schwarz, D. W. Coquillett.
Assistants: R. S. Clifton, Nathan Banks, F. C. Pratt, Aug. Busck, Otto Heidemann, A. N. Caudell, J. Kotinsky.
Artist: Miss L. Sullivan.

BULLETIN NO. 20—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.

PROCEEDINGS

OF THE

ELEVENTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., October 2, 1899.

SIR: I have the honor to transmit herewith the manuscript of the proceedings of the eleventh annual meeting of the Association of Economic Entomologists, which was held at Columbus, Ohio, August 18 and 19, 1899. From the fact that the papers presented at the meetings of this association are always of the greatest economic importance, the Department has hitherto published the secretary's reports as bulletins of this division. I therefore recommend the publication of the present report as Bulletin No. 20, new series.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
ELEVENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS	5
The *Laisser-faire* Philosophy Applied to the Insect Problem. *C. L. Marlatt*	5
A Remedy for Gadflies: Porchinski's Recent Discovery in Russia, with Some American Observations. *L. O. Howard*	24
The Present Status of the Caprifig Experiments in California. *L. O. Howard*	28
The Original Home of the San Jose Scale. *L. O. Howard* and *C. L. Marlatt*	36
Voluntary Entomologic Service in New York State. *E. P. Felt*	39
The Emory Fumigator: A New Method for Handling Hydrocyanic Acid Gas in Orchards. *W. G. Johnson*	43
Insectary and Office Methods. *F. M. Webster*	46
A Probable Remedy for the Cranberry Fire-worm. *A. H. Kirkland*	53
An Interesting Outbreak of Chinch Bug in Northern Ohio. *F. M. Webster*	55
Some Insects of the Year in Georgia. *A. L. Quaintance*	56
Notes of the Year for New York. *E. P. Felt*	60
Miscellaneous Entomological Notes. *W. G. Johnson*	62
Insects of the Year in Ohio. *F. M. Webster* and *C. W. Mally*	68
Temperature Control of Scale Insects. *C. L. Marlatt*	73
An Account of *Aspidiotus ostreæformis* (illustrated). *C. L. Marlatt*	76
Fatal Temperature for Some Coccids in Georgia. *W. M. Scott*	82
The Destruction of Hairy Caterpillars by Birds. *E. H. Forbush*	85
The Destructive Pea Louse: A New and Important Economic Species of the Genus Nectarophora. *W. G. Johnson*	94
The Stalk Worm: A New Enemy to Young Tobacco. *W. G. Johnson*	99
An Improvement in the Manufacture of Arsenate of Lead. *A. H. Kirkland*	102
Recent Work against the Gipsy Moth. *E. H. Forbush*	104
A Destructive Tan-bark Beetle. *A. F. Burgess*	107
List of the members of the Association of Economic Entomologists	110

ELEVENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, FRIDAY, AUGUST 18, 1899.

The Association met in room 4, Biological Hall, Ohio State University, Columbus, Ohio, at 10 a. m., August 18, 1899.

The following members were in attendance at the sessions:

President C. L. Marlatt, Washington, D. C.; Secretary A. H. Kirkland, Malden, Mass.; E. P. Felt, Albany, N. Y.; E. H. Forbush, Malden, Mass.; A. D. Hopkins, Morgantown, W. Va.; L. O. Howard, Washington, D. C.; W. G. Johnson, College Park, Md.; C. W. Mally, Wooster, Ohio; Herbert Osborn, Columbus, Ohio; R. H. Pettit, Agricultural College, Mich.; A. L. Quaintance, Experiment, Ga.; F. W. Rane, Durham, N. H.; William Saunders, Ottawa, Canada; W. M. Scott, Atlanta, Ga.; F. M. Webster, Wooster, Ohio.

The average attendance was increased to about twenty-five by the presence of a number of visitors, prominent among whom were:

Dr. W. J. Beal, Agricultural College, Mich.; Prof. L. C. Corbett, Morgantown, W. Va.; Dr. W. H. Hale, Brooklyn, N. Y.; Dr. B. D. Halstead, New Brunswick, N. J.; Prof. W. A. Kellerman, Columbus, Ohio; Prof. W. R. Lazenby, Columbus, Ohio; Mr. R. C. Osburn, Columbus, Ohio, and others.

After calling the Association to order, the President delivered the annual address, which follows:

THE LAISSER-FAIRE PHILOSOPHY APPLIED TO THE INSECT PROBLEM.

By C. L. Marlatt, *Washington, D. C.*

The last few years have given practical demonstration of the possibilities in applied entomology, and the subject is now being put to a more general and thorough test perhaps than ever before. The inciting cause has been, and is, the San Jose scale, which has aroused the interest and attention not only of entomologists, but of the general public throughout the world, more than any other insect problem which has arisen since the beginning of history. Never before have fears been created over so much of the earth's surface about a single

insect, and never has so much and diversified national legislation on an insect matter resulted. At no previous time also have more earnest and widespread efforts been made to prevent the spread of an insect pest or to exterminate it where it had secured a foothold.

What has all this excitement, agitation, and work demonstrated? Have we actually prevented the further spread of this scale insect? Have we accomplished by our artificial efforts in any degree its extermination? In other words, what are the practical results of the vast amount of work done and money expended?

In the same vein we may ask ourselves: Has an important insect pest ever been exterminated? Does not the locust still flourish, and is not the cankerworm still a burden? Are not all the insect plagues of our forefathers to the remotest times still with us? The commendable industry lately shown in some quarters in delving into the writings of the ancients in their reference to insect pests emphasizes the fact that many of the insects with which we contend nowadays were familiar to the very oldest writers.

In our efforts to control the normal and perhaps inevitable course of nature in any particular instance, as, for example, in our attempt to prevent the further spread and effect the extermination of the San José scale and other similarly well-established introduced pests, are we not merely repeating and putting into effect the boast of the courtiers of King Canute that at his command the tide would roll back; and are we not, like that good old king, though unwittingly, giving a practical demonstration of our own impotence by having the tide of failure roll up around our bodies?

In the foregoing introductory remarks the writer may seem to have asked questions which he can not answer, and to have stated problems the solution of which he can not give. Whether this be true remains to be demonstrated, but in his present mood he feels like voicing his doubts as to the practicability of much of our present effort and indulging in heresies perhaps; but if the interrogatories are vain and the doubts unjustified, they will at least not have been harmful and may stimulate the presentation of the real truth. The excuse, if one be required, is that opportunity, except in the case of such annual functions as the present, rarely offers for general and outside views of our special work and for philosophizing, or, perhaps, more properly, speculating, on its larger aspects. Normally one's eyes are keenly fastened on some small field of research or practical application, and one's whole energy is absorbed in making the most of every opportunity in whatever special investigation may be in hand, and it is not often, publicly at any rate, that one can break away from the narrower point of view and take a broad survey of world conditions as influenced by time in the abstract rather than in concrete days and years. Therefore, even at the risk of being charged with sermonizing and of thrashing old and well-worn straw, I have purposely taken a large

subject as giving opportunity to introduce and speculate upon some ideas which interest me for the moment, although they may not, perhaps, be altogether novel.

To explain my intention in advance, I shall make a plea, as a solution of the insect problem, for the *laisser-faire* policy in such large matters or continental or world concerns as seem to me to be beyond practicable reach by human agencies, and I shall counsel active efforts at control and prevention in such smaller and more local fields as promise adequate results. In other words, I shall attempt to separate the work in applied entomology that is practicable and profitable from work that is impracticable and unprofitable, and so benefit the former by preventing needless waste of effort.

If one could view the earth from a sufficient distance or at an elevation, as the bird sees it flying in mid-air, a condition of perfect nature would be impressed. The vegetation covering valleys and hills would seem unbroken, and all the slight abnormalities which are visible on close inspection would disappear. Only the stable conditions of a balanced nature would be visible. The stability, or the balance between animal and plant life, is evidenced by the very existence of both animals and plants, and in undisturbed nature a healthful condition of both plants and animals is the common and notable rule. One sees forests of sturdy, giant trees which have stood as they stand to-day for more than a thousand years. One may drive over hundreds of miles of unbroken prairies and not find a single spot without its covering of perfect sod. In other words, without multiplying illustration, it is evident that, in the broad view, nature is quite capable of taking care of herself, and that plants and animals have long existed and will continue so to exist without the efforts of man to protect and save either.

Much of the damage by insects which we note and herald is unusual and isolated. The occurrence of an insect in destructive numbers is witnessed, a bulletin or report is distributed, and the information thus gained is repeated in other publications for years, perhaps, while, in point of fact, the repetition of such injury may be long in coming. Even under natural conditions of virgin prairie and forest one occasionally notes instances of isolated damage. Professor Cockerell has called my attention to a notable case. The plant *Atroplex canescens* covers the country in unbroken square miles for vast areas in the Southwest, and normally presents a healthy, vigorous aspect, free from attacks of scale insects. In this area, however, one plant has been discovered literally covered with a scale insect, *Eriococcus neglectus*. Continuing the same idea, anyone who has made an effort to collect the long list of injurious insects which figure in our reports as attacking different cultivated plants knows that it takes many years of careful search to collect anywhere near a complete series, and that instances of special damage by most of the hundreds of injurious species, so called, are of very rare occurrence.

In the matter of control of injurious insects, I think also we are rather apt to overestimate the actual effort made. It is undoubtedly true that, as a general rule, in this country, and still more so abroad, no steps are taken by the ordinary farmer, fruit raiser, or trucker to destroy or prevent the presence of noxious insects. Yet I believe it to be true as a rule that such farmer or trucker is successful if he cultivates well, selects his varieties intelligently, and makes a careful study of the marketing of his products.

Professional economic entomologists are practically limited to our own generation, but insects destructive to cultivated plants are not of recent origin, nor are the conditions which are supposed to be so favorable to unusual multiplication of injurious species characteristic only of modern methods of culture. From the time man first began to till the soil and practice the arts of agriculture and horticulture, have special plants been grown in masses together, often two or three only, over whole provinces or countries to the exclusion of everything else, and such special cultures have been going on uninterruptedly for two or three thousand years in many places, as witness the olive orchards of southern Spain, Italy, and Syria, and the culture of the grape and the citrus fruits in different parts of the Old World. Instead of being despoiled by insects, as might be supposed in accordance with modern ideas, the cultures cited are as successful to-day, if not more so, than at any time in the past, and in fact are often much freer from insect damage than recent plantings in newer parts of the world, and this in spite of the fact that, as a rule, nowhere are any special steps taken to control or prevent insect depredations.

Coming to our own times, fruit raising is just as successful in California, Italy, and Spain to-day as it was before the growth of commerce introduced into each of these countries many new insects. Not one of us, also, can recall a time when he suffered for the lack of the necessaries or the luxuries of life on account of insects. We have the San José scale, the Hessian fly, the imported cabbage worm, and fifty other pests from abroad; we have such important native pests as the Colorado potato beetle and the chinch bug; yet the production of crops particularly affected by these insects proceeds with little apparent check therefrom. Occasionally an individual will suffer severely, but as a rule it will be found that it is the result of his own neglect or ignorance, and whenever there has been an absence or scarcity of any particular vegetable, fruit, or other product of the soil, the cause as a rule has not been the insect enemies, but some other adverse condition much more universal and fundamental.

The writer grew up in the great western corn and wheat belt, the home and headquarters of the chinch bug, and the first region to be visited by the Colorado potato beetle, and early afflicted also by the Hessian fly, and yet in twenty years' experience a farm was never known to be completely devastated by any of these pests. Two or

three times the Rocky Mountain locusts ate up every green thing, and the drought often impoverished the farmer, but the insects named above were never responsible for more than local or partial damage to a crop.

In other words, the normal healthfulness and balance which we have found in wild nature applies in the long run also to nature as influenced and partly controlled by man. It is the exception, not the rule, even with cultivated plants, that the damage is overwhelming and disastrous.

In taking this broader view, one is not only impressed with, but convinced of, the stability, permanence, and repose of nature in the long run. The course of life is even, and the necessary antitoxin is furnished when needed. The balance may move a little up and down, the pendulum swing more or less widely from side to side, or the line of record may be a jagged one, but the average will be the normal right line which pictures simply nature's method.

Time does not offer to consider the means by which this balance is preserved, and many of the influences at work are obscure and beyond our easy finding out. Briefly noting some of the more evident influences which operate to check undue increase of insects, disease plays a very important rôle; also any unfavorable climatic and seasonal condition, as note the result of the severe winter of 1898–99, and the effect of the occasional exceptional heat of the dry summers of California and southern Spain. Probably less important than the influences just mentioned is the action of parasitic and natural enemies, and least important of all, the puny efforts of man. From the side of the host plants the chief influences are the weeding out of the nonresistant and weaker individuals and those growing under unsuitable conditions, and the development of increased vigor and power of resistance in the stronger ones.

I have endeavored to show the self-curative and self-preservative action of living organisms in the long run. On a close inspection, especially of what concerns us personally and directly, many little ills appear, not, however, especially antagonistic to the workings of the general law indicated. These in our field of applied entomology are the local abundance from time to time of this or that injurious insect. There may be an outbreak in some limited section or in spots here and there of the army worm, the Hessian fly, the chinch bug, some species or other of locust, a scale insect, or some wood borer; or we may be temporarily annoyed by a plague of fleas or ants or flies. To correct such disturbances a knowledge of the habits, life histories, natural enemies and parasites, and of remedies is desirable; and in the control or prevention of such local annoyances intelligent effort finds an immediate practical and satisfactory outcome. In such work also the economic entomologist finds a legitimate and serviceable field for his activities. Nevertheless, the results gained, however locally valuable, affect little if any the normal course of events in the larger sense.

Every now and then, however, we are brought face to face with a disturbed balance of a more general nature, the most striking examples of which are in the new insect enemies which come from time to time, and which in new situations and under strange surrounding conditions multiply excessively and assume an economic importance which for the moment obscures all older like troubles. So universally true is it that the newcomer will prove more destructive than the old familiar pests, that this is looked upon as a fixed principle, like the law of gravity. A good illustration of this is seen in the recent very valuable book by Mr. E. E. Green on the insects of Ceylon. Referring to the insects occurring on that island, he takes the position that excessive damage by an insect is a proof of its foreign origin. He says that all the troublesome insects of Ceylon are introduced species, and that not a single undoubtedly native species has attracted any notice as a pest. Out of twenty-six species of Chionaspis, for example, occurring on the island, three only are injurious, and these are introduced species. In this country our experiences have been more varied, and we probably would not go to the same extreme, but the history of insect introductions and migrations here and elsewhere certainly indicates the truth of the general principle.

A good deal of the effort in applied entomology in recent years has been directed at evils of this sort, namely, to prevent the introduction of insect enemies from foreign lands, and to quickly exterminate or control them where they have gained a foothold.

In connection with this field of work it seems to me that the proper appreciation of certain underlying principles affecting the behavior of such introduced enemies will show that we are exhibiting much more anxiety and alarm than the occasion warrants, and that we are making vain attempts to accomplish the impossible and prevent the inevitable.

This belief has been impressed upon the writer by the history of the new injurious insects coming into prominence from time to time, and the patent failure of our efforts at extermination or quarantine.

The underlying influences referred to seem to me not to have been sufficiently considered, and offer to my mind an explanation of the excessive fecundity and destructiveness of insects and other animals transferred to new fields. In other words, I believe there are other and more important, though perhaps more obscure, agencies at work than mere favorable climate and absence of natural enemies to account for the rôle played by such introduced animals.

In the case of insects there are two points of view: First, from the side of the host; and second, and much the more important, from the side of the parasite.

Taking up the first point of view, the plant, when confronted by a new and unfamiliar enemy, is helpless, having no fund of inherited powers of resistance directly applicable to fall back upon. The struggle for existence and survival of the most fit under the old and normal

conditions has brought about a balance in which the plant and its insect enemies exist together without notable danger to the host. The disastrous effects to the host plant are, therefore, not due merely to the unusual increase and prolificness of the new enemy, but to the fact that the plant is confronted with an unfamiliar danger to which it for the time yields readily. The San Jose scale sometimes kills the plants which it infests, but the same plant, similarly infested with some old and familiar scale insect to which it has become wonted by long years of association, suffers comparatively little injury. Similarly, the Phylloxera is almost kindly in its relations to native American grapes, while the unwonted European sorts soon succumb to its attacks.

The normal powers of resistance to insect attack exhibited by healthy plants growing under favorable conditions is one of the most notable phenomena of nature, and the workings of the same principle are seen in every other department of life. The explanation is doubtless both physical and chemical. The vigorous growth of the healthy plant may often smother or crush the delicate egg or young of the insect enemy, but the chief reason is unquestionably in the character of the juices and secretions of the weakened, stunted, or diseased plant, which render it more suited and especially attractive to its insect foes.

From the other point of view, namely, that of the parasite or introduced plant or animal, there enters the very important effect of the new situation and new climatic and other conditions, the direct energizing influence of which has, I believe, never been especially considered. I believe that the records fully demonstrate that the introduced plant or animal enjoys a very notable advantage from the great vital stimulus coming to it from its new climatic surroundings and conditions of life. Of necessity it is led to put forth unusual effort and to enter the struggle for existence with more than normal activity to overcome the difficulties presented by new conditions, and as a rule this reacts to develop a more vigorous and a more fecund race.

This principle is illustrated in the higher forms of life as well as in the lower. Our forefathers, coming to the New World, met hardship and adversity, and found it necessary to strive desperately for the very necessities of life. The intensity of this struggle is apparent to anyone who will look carefully into the early colonial history of this country as pictured by Bancroft, Parkman, Roosevelt, and Fiske. The very conditions, apparently unfavorable, of those early days, developed a race of stalwarts rarely equaled in later days; men and women of brain and brawn, who were possessed of a virility and force which extended well into old age and vastly in excess of that shown by the stock from which they sprang in the Old World. Families of twelve or more children were then the rule, where four or five are now considered large.

The history of the world teaches nothing more plainly than that the migratory race is not only masterful and vigorous, but exceptionally

fecund, and rapidly peoples and possesses the invaded territory. The peace-loving and more or less effeminate race occupying the soil disappears or is swallowed up by or merged into the more vigorous invading stock. In the course of years or centuries the latter in turn becomes fixed to the soil, enervated by increasing wealth and luxury, and falls an easy prey to the next similar invasion. In a sense it is true that a migratory race in some degree is of picked individuals, the weak and incapable being necessarily left behind. This, however, applies only to voluntary migrations. The transportation of insects attached to their host plants to new localities is not accompanied by the same natural selection, and furthermore, even in voluntary migrations such selection of picked individuals is not very thorough, and often the entire stock is involved in the movement.

The true explanation is undoubtedly in the mental or nervous stimulus born of very necessity and struggle and war for existence, which furnishes an energizing and bracing excitement. The same principle operates in our own case; we appreciate the renewed zest of a fresh line of work, the bracing effect, often temporary, of a new climate, the exhilaration from the reading of a new and interesting book or indulging in a new form of attractive sport. In the vastly greater and more important struggle for existence, this mental excitement, with its accompanying brace and stimulus, is proportionately increased, and explains very largely to my mind the unusual vigor and fecundity so often witnessed in the case of introduced plants and animals.

This is, however, a temporary condition, lasting only through two or three or at most a small number of generations, and therefore in the case of insects frequently disappearing in one or two years, and rarely lasting for any considerable period. Very soon the new pest ranks with the old ones, and is occasionally abundant only, or often assumes a very secondary place. Note, in illustration, the severity of the horn fly for one season, or at most two, in each zone of territory represented by its spread inland, and many other similar cases which will occur to any of us, the most notables ones coming in my own experience being the eastward progress of the Colorado potato beetle and the purslane caterpillar.

It is interesting in this connection to note briefly the explanations commonly accepted hitherto for the phenomena in question. These explanations are undoubtedly true to a degree, but seem to me entirely inadequate of themselves. I quote a paragraph from Mr. Lounsbury giving the view commonly held, not because he originated it, for it is very old, but because he has worded it recently and in brief form. He says:

> The increased ravages of injurious insects in new countries result from the improved conditions under which they become placed. The relations which have existed perhaps for centuries between them and their food plants, their parasites and predaceous enemies, such as other insects and birds, are all suddenly broken. In their

importation their natural enemies, which had preserved a balance between them and the vegetable world, are all left behind, and they are free to increase and multiply without hindrance or molestation until native parasites and predaceous insects and animals acquire the habit of preying upon them.

Mr. Scudder, in an admirable excursus, speaking of this continent only, explains these phenomena by that intensity which seems to characterize all life in America, and which, in so far as the human race is concerned, marks us as a restless, hurrying, energetic, enterprising people. In explanation of this condition Mr. Scudder cites the greater extremes with us in variation of temperature. The mean annual temperature, for example, of New York City and Frankfort is approximately identical, but the summer temperature of New York is that of Rome, and the winter of St. Petersburg. Changes are also quicker from summer to winter, and our summers are longer and have a marked preponderance of sunshine compared with the same seasons in Europe. This, according to Scudder, explains the greater virility and fecundity seen, especially in the case of animals, on this continent. In illustration of this he shows that, as a rule, among all butterflies properly comparable on the two continents, that is, as to climatic situations as well as generic relationships, there is no single instance where the European butterfly has more broods than the American, and very generally the latter has one to several broods more than the former.

As accounting for the comparative freedom of European agriculture and horticulture from destructive attacks of insects, the argument from the standpoint of climate appeals to me strongly, and has already been urged by me in an address before the Entomological Society of Washington last year. A personal examination of the conditions convinced me that an unfavorable climate has much to do with the immunity from notable damage in Europe as compared with America. The shorter and cooler summers of middle Europe, comparable to our fall and early winter almost, do not foster the multiplication of insects as do our longer and hotter summers; and furthermore, in Florida and in the coast region of California the effect of the longer summers is accentuated by another favorable condition, viz, the greater humidity as compared with the portions of Europe where the crops are similar, as, for example, Italy and Spain.

A purely theoretical explanation noted, but rightly, in my judgment, not indorsed, by Dr. Howard in an annual address before Section F, American Association for the Advancement of Science, in 1897, is that the flora and fauna of America, the older continent, have become degenerate through age and can not successfully resist competition with the more vigorous forms introduced from the younger continent of Europe.

All these explanations, except the first, call for continuous action, and the more important of the conditions involved in them doubtless exert such influence on all life in the New World, but the phenomena with which we are specially concerned, namely, the extraordinary

increase and destructiveness of imported insects, is a temporary one, and, to my mind, is largely to be explained by the mental and nervous conditions cited at the outset, rather than by external causes.

In summing up this phase of the discussion it seems to me that while we may normally suffer rather more from insect depredations than the Old World, as a result of a more favorable climate, and while the foreign insect enemies coming to us may assume extraordinary powers of multiplication and corresponding damage, we have, nevertheless, the satisfaction of knowing, in the case of the last at any rate, that ultimately, and often in a very short time, by the action of the fundamental principles noted, the more serious symptoms will disappear and our plants will acquire new powers of defense.

A brief examination of the results of our efforts at control in these larger and more general concerns will, I believe, show their general impracticability, and will emphasize the wisdom of the *laisser-faire* or let-alone principle of action in such matters.

In our opening sentences allusion was made to the strenuous efforts of the last few years in different countries to prevent the introduction of certain noxious insects by the enforcement of inspection and quarantine regulations and in various prohibitions on the freedom of commerce. The general impossibility of excluding insects by inspection and treatment of introduced stock was convincingly shown by Dr. Smith in a paper read before the nineteenth annual meeting of the Society for the Promotion of Agricultural Science last year in Boston, and this point of view has been very strongly impressed upon the writer from the outset. To cite a notable example: In 1890 the Department introduced some half a hundred small date-palm trees from Egypt and Algeria. These proved to be thickly infested with scale insects and were kept at the Department under surveillance and treatment for six months, being subjected some dozen times to various methods of treatment, and were ultimately distributed and planted. In spite, however, of the strenuous effort made to destroy the scale insects in question, and the apparent absolute freedom of the plants from the presence of the scale when sent out, it needed merely a year or two for the scales to develop as badly as ever. In fact, on account of the overlapping and clasping of the basal part of the leaves of the palm, it proved to be absolutely impossible to reach and exterminate the scale secreted there by any means whatsoever short of killing the plant. With this same plant also a mining insect was found, which lived deeply embedded in the thick part of the plant, absolutely beyond the reach of any gas or wash or of any possible treatment.

The experience cited has been duplicated many times with introduced stock, and is not a novel one by any means. Take a carload of plants, consisting of thousands of trees and shrubs, such as was recently received by the Department of Agriculture from Japan; no amount of inspection, even if conducted by an assemblage of all the recognized

experts in this country, could discover all possible sources of contagion. Nor is there any method of fumigation or disinfection that is absolutely effective. We have, therefore, no means of assuring the prevention of the introduction of noxious insects or fungous diseases by inspection or treatment.

If the principle of protection from foreign pests were followed out legitimately by all countries, it would practically stop the commerce of the world, except in mineral substances, and even then the chance of stowaways would not be avoided. Either we must build a Chinese wall and live entirely apart from the rest of mankind, or make up our minds ultimately to be the common possessors of the evils as well as the benefits of all the world.

There is another view of this phase of the problem of insect control which has latterly impressed itself upon us much more than formerly, namely, the undesirability of exciting alarm on the appearance of a new pest. A subject taken up as was the San Jose scale grows in importance from week to week and as it spreads from country to country, while as a matter of fact the insect itself and the likelihood of damage may not be essentially different in kind from that to which we are subject from a hundred other insects, and which attends every shipment of plants or fruit from any quarter of the world; but suspicion aroused, restrictions on commerce and exchange follow.

It seems to me, referring again to the San Jose scale, that the chief distinction between this insect and many other imported species is not that it is so much more destructive and dangerous, but that it had the bad fortune (for us) to get thoroughly established in two of the leading Eastern nurseries and to be thence distributed over a very large extent of territory in a very short space of time, so that during its first and most destructive period in the East it was brought into very general notice. It is not especially feared to-day in California, and, in fact, it is looked upon by some of the largest fruit growers—as I am informed by Professor Washburn—as having been of positive advantage, the yearly treatment of trees having necessitated a system of regular short pruning, which has greatly improved the quality of the fruit and much lessened the expense of gathering. The experience on Catawba Island, which is familiar to all of us, is another case in point, and I venture to predict that this insect will not be especially feared in the near future by our Eastern fruit growers.

Aspidiotus ostreæformis, recently introduced from Europe, is liable to be just as dangerous an insect as *perniciosus*, and if it should be similarly widely distributed and equally actively exploited would doubtless assume a similar importance, but with this advantage, that coming from Europe to us there could be legitimately no restrictions on our commerce by European powers in consequence.

Recently the Department was urged by an enthusiast on the subject to prepare and distribute an alarm circular or bulletin on *Aspidiotus*

articulatus, common in the West Indian Islands and in Central America and Mexico. The folly of such a course is evident when it is remembered that this scale insect has been present in tropical America for a century, if not longer, and commerce has proceeded without restriction heretofore on that account; and our southern States, the ones most likely to suffer, have never received any damage therefrom. As a matter of fact, this scale insect gained a foothold at Key West many years ago, and perhaps in other places in the extreme South, but it has never caused any notable damage, nor, in fact, any damage worthy of reporting.

Taking a radical view, one may even question whether it would not be better in the long run, instead of trying to keep out injurious insects, with the necessary troublesome and mischievous restrictions on commerce of all sorts, to let such matters take their own course. The result ultimately would be a stable condition, and we would not be wasting our efforts in quarantining our shores or our several States from foreign pests, but could spend it in finding out the best methods of controlling these enemies. As a rule, plants are affected by only one injurious insect at a time, speaking more particularly of the scale insects, and it does not really make much difference which one if we know how to control it. At any rate, I am inclined to believe that much of our effort in the line of quarantine and inspection, and restrictions on commerce, except perhaps, for the detection and stoppage of notoriously infested stock, is wasted energy; for I believe that ultimately, in spite of all we may try to do, the principal injurious pests of cultivated plants will extend their range wherever the host plants are grown. If this be true, why make mountains out of what may after all be molehills; see horrible menace in easily-controllable enemies; exploit to the utmost simple evils, thus putting the products of a whole country under suspicion and unfairly restricting its commerce?

This does not necessarily mean that we are to abandon all inspection of foreign stock, or to give up all quarantine regulations; nor does it mean that we are to open our doors freely to the insect pests of all foreign countries; but it does mean that it is highly desirable to fairly count the cost and view dispassionately the limitations attending such work.

The other line of effort which seems to me to be often of questionable utility is that directed toward extermination. I have already alluded to the fact that not a single notable case of extermination of an insect at all well established, has been effected by the agency of man; nor do I believe that such result will ever be accomplished. The stamping out of the Colorado potato beetle in Germany is not a case in point, because this insect never was established in the true sense, and, furthermore, it is a large and conspicuous species, limited in Germany to a single food plant grown only under cultivation.

We may, it is true, by the expenditure of a large amount of money and the most earnest effort, effect a very complete checking of damage

and render an insect pest temporarily rare, but the moment there is any relaxation the pest will undoubtedly return and within a year or two be as firmly fixed as ever. With most insect pests, the range of food plants is so great and includes so many wild plants which can not be reached that it is only a matter of time before an apparently exterminated pest reappears. The world is too large and insects are too small and numerous to leave any chance of extermination by our puny efforts. Moreover, when our best methods are scrutinized, it is seen that we have no insecticide or form of control which is absolutely perfect and sure. Our gas treatment, which is our greatest triumph, in the hands of the most careful expert will not kill all of the scale insects on a badly infested plant, and in California, the home of this method, it is found necessary to fumigate every two or three years.

Does anyone think for a moment and at all seriously that the San Jose scale is to be exterminated, and that its dissemination is to be prevented, whatever may be the legislation, and whatever quarantine steps may be adopted or exterminative measures put in operation? Undoubtedly this scale insect will overspread North America within the possible climatic range of the species, and ultimately, and at a not far distant date, will become established in Europe despite all possible preventive efforts. I question, in fact, if it does not even now occur in many of the botanical gardens of Europe, in most of which are growing many plants from Japan, the probable native home of this scale, and whence it has four times been received by the Department of Agriculture the present year.

The same interrogatories may be made in regard to any other insect similarly securely established in our midst. The history of every important injurious insect imported into this country, or spreading from some particular section within our borders, seems to have but one lesson. In each instance is noted a natural uninterrupted extension of the invaded territory, accompanied, as a rule, by an unusual and excessive abundance of the pest during its first years, and consequent serious losses in crops attacked, and, in subsequent years, a decrease in numbers and amount of damage until a normal condition obtains and the pest is no longer especially feared. Note, for example, the eastward march of the Colorado potato beetle and the purslane caterpillar, the southern spread of the imported cabbage butterfly, the extension westward of the horn fly, the migration northward of the harlequin cabbage bug and the house centipede, and similarly of fifty other insects which might be mentioned.

It seems to me that the things here witnessed, namely, the natural spread and migration of insects, are inevitable and largely beyond control in their larger aspects. I do not believe, to repeat, that it is possible to limit for long the natural spread within our own borders of introduced insects any more than it is possible to prevent the coming of foreign insects to our shores. These are world movements, the work-

ings of fundamental law, and our efforts to resist them are often ridiculous and wasteful of money and energy.

If, therefore, we can not keep out an injurious insect, or prevent the spread of the insects within our borders, and if, more than all and as a prerequisite to the first two propositions, we can not certainly effect the extermination of a single insect, what then is our legitimate course? I shall not question anyone's right or liberty to undertake any line of work which he may think feasible and profitable, but for my part I feel convinced that local control represents the major part of the field that offers any hope of practical results in applied entomology. By local control I mean, in the case of the San Jose scale, for example, such work as that done in California with the lime, sulphur, and salt wash, or the excellent results gained in Maryland during the last two years with hydrocyanic acid gas, or the very successful experience with fish-oil soap on Catawba Island, or the recent demonstration of the value of crude petroleum in New Jersey. The total extermination of this scale even locally is not accomplished by any of this work, but a practical control is gained and often so perfect as to protect the treated trees for two or more years. Further than this, we may by law enforce the undertaking of some one of these or some other kind of control whenever it is shown to be necessary. We may check the heedless sending out of infested nursery stock by providing perhaps for a year's guaranty or making payment obligatory only after a year's test has shown the freedom of the stock from scale. All these and similar forms of control of the San Jose scale are legitimate and feasible, and are included in what is meant by local work.

As a basis for such local work for all injurious insects will be needed the fullest information obtainable on their life history and habits, and also the discovery of the best remedies and preventives. We may have State, county, and orchard inspection, and enforce curative measures. We may assist the action of natural laws by the introduction of enemies of injurious species. With a proper appreciation of its limitations we may even adopt a system of inspection for the detection and stoppage of palpably infested stock coming into a country or State. But our main object should be to disseminate knowledge of local methods of control, make it possible for the intelligent and progressive man to protect his own crops, and cause him to realize that the failure of his neighbor to take the same course will give him so much additional profit and advantage.

In concluding this address I will briefly summarize the points I have endeavored, successfully or otherwise, to demonstrate. I started out with the plea for the *laisser-faire* policy in the larger or world concerns, which seem beyond human reach, and urged the limitation of efforts at control and prevention to such smaller and local matters as promise practical results. In support of this point of view I have endeavored to picture the harmonious action of Nature in the long run, her abun-

dant powers of self-protection or recuperation, and to indicate the equal applicability of this law to both primeval and artificial conditions, or wild nature and nature as influenced by man. I have attempted to show also the local character, when broadly viewed, of most damage from insects. I have endeavored to explain the underlying principles accounting for the excessive multiplication and resulting injury, usually temporary, characterizing new or introduced species.

In further support of the *laisser-faire* policy, as limited above, I have pointed out the futility, in the long run, of attempting to keep out foreign insects, or of preventing their ultimate natural spread within our borders, and have shown that these are world movements and the workings of fundamental law, and not to be thwarted in their final accomplishment by our puny efforts. In the same connection I have shown the great undesirability of exploiting what are probably short-lived, or at least easily controllable ills, thus unfairly putting restrictions on commerce. In the further support of the same policy I have attempted to demonstrate the absolute futility of our attempts to exterminate pests once at all well established, and I am finally led to the inevitable conclusion that local control as outlined above is the chief, if not almost sole, legitimate field of effort in applied entomology.

A general discussion of the address followed its reading, Mr. Osborn presiding. The views expressed as recorded by the secretary and subsequently revised by the several participants were as follows:

Mr. Osborn stated that there was much in the address with which he heartily agreed, but that he feared it might be misinterpreted in some quarters, and that some of the statements seem not to be warranted by the facts. There is so much difference in the habits of different insects, their mode of attack, and means for migration or dispersal, that they must be considered separately, and it seemed to him that our duty as economic entomologists is to determine these facts and urge the adoption of all measures which may protect our constituents in their different localities from insect invasions or ravages. Pleuro-pneumonia would not have been suppressed under a *laisser-faire* policy, nor the control of Texas fever achieved; and so also with smallpox or yellow fever. We could not hope for many triumphs in applied entomology if this were allowed to be our watchword or become the policy of the communities for which we labor. He believed that economic entomology had accomplished some valuable work in some of these lines, that loss had been prevented, and that injury might often be lessened, or the spread of an insect retarded to the extent of preventing tremendous losses in certain regions. He felt certain that, in drawing a line for the application of the *laisser-faire* policy, many people would adopt a very different one than would be drawn by our worthy President.

Mr. Howard regretted the use of the term "*laisser-faire*," since its literal interpretation would not properly represent the author's position. No great problem of insect extermination had appeared until within the last few years. The work against the gipsy moth was a case in point. Here the undertaking seemed hopeless until a thorough and scientific examination of the infested region and the methods adopted showed it to be possible. In the paper referred to as read before the Society for the Promotion of Agricultural Science, Dr. John B. Smith had shown that many insects escape even vigilant quarantine measures, but, notwithstanding this, cases of severe infestation are detected and destroyed. The hidden insects may slip by, but the great tide will be arrested. Even Dr. Smith admitted the effectiveness, to a certain extent, of the quarantine system, and, in regard to inspection, stated that he believed it to be a good thing, that it would make shippers more careful, and that fruit growers would probably get better and cleaner stock than received otherwise. Mr. Marlatt himself admits the advisability of the stoppage of palpably infested plants at the port of entry. So, after all, the advisability of quarantine and inspection measures seemed to be admitted on all hands, but too much must not be expected of them. The efficacy of quarantine had been well illustrated by the excellent work of Mr. Alex. Craw at San Francisco.

With regard to the San Jose scale the speaker held that the warnings which the entomologists gave to the fruit growers and to the nurserymen on its first discovery in the East were perfectly justifiable, and that on the whole the alarm excited had been productive of great good. Much beneficial legislation had been enacted, and the work done against this insect by the small army of workers had greatly increased our knowledge of the action of insecticides, both upon insects and upon plants, and enlarged our ideas as to the best methods of applying.

While the tone of the address may be considered to be pessimistic, and its temporary effect depressing, we must admit that it is highly original and its arguments ingenious. The broad significance of local measures and local work, as defined by Mr. Marlatt, must not be overlooked. The field of work to which he would restrict the entomologists still includes practically everything which we are doing and intend to try to accomplish. The address must be read at leisure and assimilated slowly.

Mr. Webster called attention to the fact that while the propositions laid down in the address were less difficult of comprehension by intelligent people, the ignorant, the obstinate, and the lazy would gladly avail themselves of the opportunity to take refuge behind the author's statements, the effect of which, distributed as they will be through the agricultural press, will be to promote neglect and shiftlessness regarding insect pests in general. Misconception of the address is to be feared, even among the intelligent, and for others it will be easy and disastrous. If foreign pests came to this country naturally, we should probably

suffer less from their multiplication and the address would be more applicable, but they are imported by man in a wholesale manner, and, while it has been said that such importations will prove a blessing in disguise, in the case of the San Jose scale it is deeply disguised. Because efforts at quarantine have not kept out all insect pests, it is no reason why they should be abolished. We could not know whether they would fail or not. The San Francisco quarantine station, the only one we have, certainly indicates that they will afford a very great protection. We do not execute our physicians because they do not cure all of their patients.

Mr. Forbush showed that the practical question of exterminating or controlling insects had an optimistic as well as a pessimistic side. While the extermination of many imported insects was impossible, in other cases, where the species was handicapped by physical defects, such extermination might be possible. With the gipsy moth the female is handicapped by an inability to fly; hence the spread of the species is slow. This insect has been absolutely exterminated from hundreds of localities and from whole towns. The spread of the insect over Massachusetts and other States has been prevented. Had the *laisser-faire* policy been followed many States would now be suffering from this pest.

Mr. Hopkins congratulated the President on his most interesting and suggestive address. He believed it to be the mission of this Association to consider and thoroughly discuss just such problems as those presented. A knowledge of these broad world movements and the laws which influence them for the good or harm of man would help us to successfully deal with the small local ones. He fully agreed with the President that many of these national problems were beyond the control of human agencies and that the let-alone policy would, in most cases, as applied to them, prevent a vast amount of wasted energy, time, and money. At the same time he felt that all new problems, whether great or small, should be thoroughly investigated by one or more specialists in order that it might be determined whether or not it were best to adopt the *laisser-faire* policy. If the economic entomologist can give, from facts determined by original research, information which will lead to the prevention of great losses to a nation, state, or community, by adopting this policy, his services are none the less valuable.

Mr. Johnson said he feared that the deeper meaning of the address would not dawn upon the average reader; that he had been unable to interpret its real intent; from the philosophical standpoint it was a fair production, but from the practical side it would surely be misinterpreted and lead to much confusion. He felt it would be useless for him to enter into a detailed discussion of the paper, as he could not indorse it in any way. His familiarity with the work of Mr. Craw, and his knowledge of existing conditions in California and the West; his personal

experience with economic problems in the field, and the practical results gained with hydrocyanic acid gas; and his observations on the work of the gipsy-moth committee in Massachusetts, all confirmed his belief in the good results of the strictest quarantine, local inspection, and concerted action on the part of growers; also the utility of men trained in the field rather than in the office for handling economic problems. He insisted on the absolute certainty of the gas method for controlling dangerous injurious insects in orchards and nurseries, especially the latter. He felt that the sentiment permeating the paper could be used by so-called legislative reformers to prevent State or national legislation. While he understood and appreciated portions of the paper, he felt certain that it would tend to discourage economic workers, and that the general distribution of the paper would lead thousands of farmers to fold their arms and await a harmonious and perfect balance of nature, ignoring and ridiculing the suggestions of economic workers.

Mr. Felt said that while agreeing in the main with the opinions expressed in this admirable address, the liability of misinterpretation by careless readers led him to state that this Association could not go back, even by implication, on well-directed efforts to exclude or exterminate certain notorious insect pests. The present laws of New York are doing much to prevent the spread of scale insects.

Mr. Marlatt, in closing the discussion, said it was easy to be led by side trains of thought away from the real subject of debate. Much of the criticism by the preceding speakers illustrated this statement. In view of this misunderstanding he thought it well to recall the object and purport of the address as explained at the outset, namely, to make a plea, as a solution of the insect problem, for the *laisser-faire* policy in such large matters of continental or world concern as seemed to him to be beyond practicable reach by human agencies, and to counsel active efforts at control and prevention in such smaller and more local fields as promised adequate results; in other words, to attempt to separate the work in applied entomology that is deemed practicable and profitable from work that is deemed impracticable and unprofitable, and so benefit the former by preventing needless waste of effort. He said that a misunderstanding was evident in the minds of several as to his, the speaker's, attitude toward inspection and quarantine, but he felt sure that an examination of the portions of the address relating to this subject would indicate that legitimate quarantine to check or limit as far as practicable the transmission of notoriously infested stock was distinctly included in the field of useful effort.

Considering the paper as a whole, he said that a broad view had been taken of the interrelations of insects and plants, and the general balance of nature in this regard had been pointed out, not as an excuse for the neglect of any feasible work, but to prevent the rousing and promulgation of unnecessary and hurtful fears. An attempt had been

made to show the impossibility of preventing in the long run the natural spread of insects, the futility of attempts at extermination of well-established pests, and the folly of viewing with alarm matters that had been going on for thousands of years without very great hurt to human interests. For such matters he had urged in the broad sense, and not locally, the *laisser-faire* philosophy, the nature method of control, and had pointed out the successful and satisfactory character of such action in the long run, and also the temporary character of most of the ills which we have allowed unnecessarily, it seemed to him, to excite and alarm us.

On the other hand, he had urged the concentration of our energies on all fields of local work which promise direct and practical results, and in no sense had counseled an abandonment of any legitimate useful effort, as was fully indicated in the latter portion of the address.

In conclusion, he expressed the belief that we had of late shown too much readiness to become alarmists. He himself had been guilty as well as others, with the result that commerce with foreign countries and among ourselves is now suffering most severely. He asked the question, Has this been necessary or worth while? It seemed to him that the outcome of the Colorado-potato-beetle scare of years past indicated the true answer to this query. He said: Does anyone believe to-day that the potato beetle constitutes a menace to the production of the Irish potato? In point of fact, the constantly increasing range of this beetle scarcely attracts notice or comment, and yet in the early years of the eastward march of this insect, no other pest was so feared or so exploited. Foreign countries, notably Germany, as now with the San Jose scale, were terrified at the calamities with which the anticipated introduction of the potato pest threatened them. It is true that this beetle has not gained lodgment in Europe, but in this country it is practically everywhere, and yet the fears first aroused have absolutely disappeared. On the other hand, however, the discovery of the value for insecticide purposes of arsenicals which resulted from the coming of the Colorado potato beetle has saved for this country thousands of dollars for every dollar lost by reason of this insect.

Many other important injurious insects have had a similar history in this country. The San Jose scale itself in California is a good example. As already noted in the address, it is far from being a menace to fruit culture in California to-day, and in the district where it was most feared and injurious it is now scarcely present at all, and generally for the State it has actually been a decided benefit to the fruit grower. In the East, also, as noted by Dr. Howard, its presence and rapid spread has greatly stimulated work in applied entomology, and this has already resulted in the discovery of new and valuable means of controlling scale insects and the improvement of old methods, so that undoubtedly, as with the potato beetle, the final outcome with the San Jose scale will witness, in the East as well as West, an actual betterment of conditions.

Following the discussion, Mr. Osborn called the attention of the association to the fact that the sessions were to be held in the rooms consecrated to the advancement of entomological knowledge by the many years of faithful service of the late Dr. Kellicott, and an invitation was extended to freely inspect Dr. Kellicott's valuable and extensive collections, particularly of Odonata.

The report of the treasurer was then presented and accepted, showing a cash balance of $8.60.

Active members were elected as follows:

C. S. Banks, Albany, N. Y., proposed by Mr. Felt.

Arthur Gibson, Ottawa, Canada, proposed by Mr. Kirkland.

H. P. Gould, College Park, Md., proposed by Mr. Johnson.

S. J. Hunter, Lawrence, Kans., proposed by Mr. Howard.

The foreign members elected were:

Edward Barlow, Calcutta, India, proposed by Mr. Webster.

E. E. Green, Pundaluoya, Ceylon, proposed by Mr. Howard.

A. M. Lea, Hobart, Tasmania, proposed by Mr. Chittenden.

J. G. O. Tepper, Adelaide, South Australia, proposed by Mr. Howard.

Mr. Webster and Mr. Lazenby, on behalf of the Society for the Promotion of Agricultural Science, extended to the entomologists present an invitation to attend the meeting of that body.

Messrs. Webster, Howard, and Johnson were appointed a committee on programmes for the following sessions and also to arrange for a joint session with the Society for the Promotion of Agricultural Science.

Adjourned to 2 p. m.

AFTERNOON SESSION, AUGUST 18.

Association met pursuant to adjournment.

A committee on resolutions was appointed by the chair as follows: Messrs. Howard, Osborn, and Felt.

Mr. Howard then presented the following paper:

A REMEDY FOR GADFLIES: PORCHINSKI'S RECENT DISCOVERY IN RUSSIA, WITH SOME AMERICAN OBSERVATIONS.

By L. O. Howard, *Washington, D. C.*

Through the kindness of Dr. Peter Fireman, of the Columbian University of Washington, D. C., a Russian of high scientific attainments, the writer has been able to familiarize himself with numerous recent entomological articles published in the Russian language, and particularly those which relate to the work in economic entomology done under the Russian Government in the different provinces, all of which being published in the Russian language are inaccessible to most English-speaking workers.

One of the most striking of the recent articles has been called to my attention by Dr. Fireman, who has prepared the English abstract which

will presently be given, and which treats of what is, without doubt, under certain circumstances, a practical remedy against the so-called gadflies of the family Tabanidæ, a widespread group of insects comprising nearly 1,500 species, of which about 150 occur in North America. The injury which these insects do by annoying live stock and reducing their condition, as well as by occasionally transmitting a case of anthrax or malignant pustule to human beings, is sufficiently great to make the matter of remedies of some slight importance. The bite of the adult fly in itself is rather severe and painful, but does not seem to be so poisonous as that of mosquitoes or buffalo gnats. A full account of what is known of the habits of the more abundant and prominent of the North American species will be found in Professor Osborn's excellent account of the insects affecting domestic animals, published as Bulletin No. 5, new series, of the Division of Entomology, of the U. S. Department of Agriculture.

Just as Professor Porchinski points out for Russia, so in the United States no practical remedy has been definitely suggested for gadflies. The oily mixtures applied to cattle as preventives against the attacks of the horn fly, stable fly, and the botflies, will doubtless act as deterrents to the gadflies, but there has been lacking any suggestion of the simple and practical nature of that advanced by Porchinski, fortified as it is by an apparently full and careful series of experiments.

It is a great satisfaction to the writer to find that he anticipated by observation, though not by extended experiments, so interesting and important a paper. In his experiments in the summer of 1892 in the use of kerosene against the larvæ of mosquitoes in the Catskill Mountains, the results of which were presented before the Association of Economic Entomologists at its fourth annual meeting, at Rochester, N. Y., in August of the same year, he discovered, and recorded on page 13 of Volume V of Insect Life, the fact that among the insects captured by the kerosene on the surface of the small pool upon which he was experimenting were 27 specimens of *Chrysops hilaris* O.-S., one of the commonest gadflies of that region. The experiments were conducted against mosquitoes, and the significance of the gadfly captures was not pointed out in the article referred to. Nevertheless, the published note may be considered both as anticipatory and confirmative of Porchinski's results.

TABANIDÆ AND A VERY SIMPLE MEANS OF DESTROYING THEM.

By I. Porchinski.

[Syelsk. Khoz. Lyesovod. (Agriculture and Forestry), vol. 192, pp. 557–574, St. Petersburg, 1899.]

Tabanidæ occur in the whole territory of Russia, from the Arctic regions to her southernmost latitudes, and the farther south the greater the number of species. Although at the north the number of species is smaller, they multiply in some localities in enormous quantities. Of the larger species at the north of Russia there are notable, besides *Tabanus tarandinus*, which is a veritable scourge of the northern deer, *Tabanus bovinus*, the ordinary *T. montanus*, *tropicus*, and *luridus*, and the old

T. bromius, and *maculicornis*. Of the smaller Tabanidæ must be mentioned *Hæmatopota pluvialis* and *Chrysops relictus* and *Ch. cæcutiens*.

Of the author's observations in regard to the habits of various species only the following may be mentioned: The *Hæmatopota pluvialis* apparently does not like objects of a white color. In its attacks upon animals as well as in selecting a place of rest this insect makes use mostly of objects of a dark color. Thus, in white clothes, I always was less subject to its attacks than when wearing a gray or dark suit, and the same was true even before a rain when these insects are most unbearable and least particular. White horses, according to my observations, suffer comparatively less than those of other colors, especially black ones.

Water and arboreal plants are the chief conditions of the existence and multiplication of the Tabanidæ; where these conditions are absent no Tabanidæ are observed.

Scarcely anywhere is man engaged in actively combating the Tabanidæ; all the measures thus far applied are merely in the nature of palliatives. Of the latter perhaps the most in use is fish fat (blubber?) applied to the animals as a grease. Not only is man powerless in his fight against these insects, but in nature also as far as we know they appear to have few enemies. In North America a parasite has been discovered which destroys the eggs of the Tabanidæ. This parasite belongs to the Hymenoptera and lays its eggs in those of the Tabanidæ. In Russia as a dangerous enemy of the Tabanidæ appears the fly-eating wasp, Bembex, which raises its larvæ at the expense, among other insects, of the Tabanidæ. However, this wasp does not confine itself to the Tabanidæ; it is very omnivorous and seizes various Diptera, but in the presence of Tabanidæ prefers the latter. Soaring in the air at almost a man's height, with a fine characteristic buzz, the Bembex throws itself with the velocity of a flash upon the Tabanus, seizes it, and carries it into its burrow. It is probable that the scarcity of Tabanidæ in some places, apparently very favorable for their existence and multiplication, is due to the presence of the fly-eating wasps which, to be sure, in their turn, suffer from their parasites (the wasp Parnopes and the fly Miltogramma).

Our extremely limited knowledge of the life and properties of the Tabanidæ offered very little promise of discovering a convenient means for their destruction, when in the summer of 1898, while riding in a locality very rich in Tabanidæ, I decided to take up this question. By observation I soon discovered certain habits of these insects which render their destruction a very simple matter.

My observations in this connection were made at a northern latitude (in the neighborhood of Paolosk), and therefore related to a small number of species of Tabanidæ; but these species are very widely distributed and very rich in individuals. The Tabanidæ about which I speak seem to experience a strong desire for water, which leads them to frequent places where it can be had. Observing these insects, one can not fail to notice how they collect in particular places on the so-called dances of the males, when the latter, soaring in the air at one point, suddenly fly to one side and continue the same maneuver at another point. Some places appear to be especially liked by them, and there they are sometimes found in such numbers that it is difficult to pass them without receiving several stings. Careful observations have shown that such favorite places of the Tabanidæ are distinguished by great humidity, and usually have one or more pools when such on higher places have already dried up. Such humid spots in the clearings amid the woods and in the neighborhood of wide, open roads in the woods are veritable nests of the Tabanidæ. Hither they come from over a considerable area of the woods, and thence they again fly away in all directions. If we watch such a pool, we soon notice that both males and females of the Tabanidæ come to it constantly, lower themselves quickly to the surface of the pool, and taking some water with the proboscis, fly away again. The contact of the Tabanus with the water does not present any danger for the insect, as only a part of the lower surface of its body touches the surface of the water, so that the Tabanus is not even wetted by the water, owing to thick down on the lower surface of the

thorax and to the hair which covers its legs. This taking of water by the Tabanidæ continues during the entire warm part of the day; but not infrequently I observed that, on some days especially, large multitudes of them came to the pool after 3 or 4 o'clock in the afternoon, flying to the water, not in swarms, but singly, from all directions.

This habit of the Tabanidæ appeared to me in many respects very important, especially in the matter of destroying these insects. It appeared to me that if the surface of the water were covered with a liquid which would wet the lower surface of the insect's body at the moment of its contact with the water the insect would stick to the surface of the water and thus perish. With this end in view, I applied kerosene, a liquid which, on getting on the body of the Tabanus, spreads, like oil on paper, until it covers the whole body, including the spiracles, and thus causes the destruction of the insect from suffocation, even in the case when it succeeds in tearing itself away from the surface of the pool. Kerosene fully justified all the hopes which I placed in it. By the third day of my experiments the "pool of death," as I called it, was covered with large floating islands of the corpses of the Tabanidæ. These islands soon reached the shore, and, on the lowering of the water level by the heat, covered thickly the borders of the pool.

The insects, in attempting to take in water by the proboscis, were at once wetted by the kerosene and became stuck, as it were, to the surface of the pool. In their efforts to tear themselves away from the oily surface by the aid of their wings, they circled with great velocity on the surface and soon perished. In some cases, not at all infrequently, they succeeded in flying away, but in all such cases they either let themselves down near by on the leaves of some bushes or they flew farther with a peculiar unusual buzz. Their fate, however, was only postponed a few hours. They soon perished (sometimes in five to six hours) from suffocation and poisoning, so that at different distances from the "pool of death" could be found dead or dying Tabanidæ whose bodies were more or less covered with kerosene. The "pool of death" not only attracts the Tabanidæ from the immediate neighborhood, but from remote places, especially when there are no other "pools of death" near by. Moreover, further experiments and observations showed that the presence of other pools, brooks, and creeks does not detract from the importance of the "pools of death" for this reason, that a Tabanus has only to attempt once to take water from the "pool of death" to find certain death, and the insect will certainly make this attempt, owing to the very active life of the Tabanidæ, which fly with great power and for long stretches of time. Lastly, it must be mentioned that the most of the Tabanidæ very unwillingly fly to open places much removed from the woods. For instance, I rarely saw Tabanidæ taking water from a river flowing less than half a mile from the nearest parts of the woods where these insects swarmed in great numbers; they always took water from a stagnant pool near by.

To the 'pool of death" came and met their death all the species of Tabanidæ (*Tabanus bovinus, montanus, tropicus, luridus, solstitialis, borealis, maculicornis, Chrysopa relictus,* and *Ch. cœcutiens*) [flying] at the time and the place of my experiment. Only the Hæmatopota did not take to the water, and therefore cannot be destroyed by this means.

As to the quantity of kerosene required: To a few square arshin (1 square arshin= 0.6 square yard) of the surface of the pool half a pound of kerosene was applied; if then the first male Tabanidæ which attempted to take water got stuck, a like quantity of kerosene was added on the following morning; on the other hand, if they escaped, more kerosene was added immediately. The required quantity of kerosene is best poured at different places of the pool, so as to facilitate the covering of the whole surface with a uniform layer of the oil. It is essential to add every morning fresh quantities of kerosene.

In the selection of the pools for treatment with kerosene care should be taken to select those where the Tabanidæ swarm in greatest numbers and which are for one reason or another attractive to them. If there are only a few such, it is best to con-

vert them all into "pools of death." It must be remembered that the pools must contain stagnant water.

The application of this means of exterminating the Tabanidæ may entirely free a locality from them, especially if the pools are prepared as soon as the insects appear and are maintained until their total disappearance.

The habit of the Tabanidæ of taking up water in general and particularly from stagnant pools may have great importance in determining the part which they play in the matter of transmitting disease-producing principles directly into the blood of animals.

Lastly, the "pools of death" will enable the collection of Tabanidæ in large numbers and so further the study of rare species and lead to the discovery of new ones. It must be added that though kerosene affects the color of the insects, the normal color is restored as soon as the kerosene volatilizes. A month after the insects had been taken from the "pool of death," they did not differ in any particular from those that had been well preserved and caught on the flowers or while flying.

In conclusion the author recommends the use of kerosene in combating Culex as applied in the United States.

Mr. Marlatt called attention to the great difficulty heretofore experienced in attempting to deal with this class of insects. Their life history had not offered a vulnerable point and Mr. Porchinski's discovery would doubtless prove of practical value in many parts of the United States. He referred to the abundance of Tabanids on the marshy shore strip, especially in New Jersey, and where the use of oil for the destruction of these flies would be on the same basis as its use for the control of the mosquito pest already instituted in one or more localities.

Mr. Osborn inquired concerning the probable limitations of the remedy, particularly if it would be applicable to large bodies of water.

Mr. Hopkins expressed the opinion that Tabanids would not be found frequenting bodies of water of the size of the Great Lakes.

Mr. Scott spoke of the abundance of gadflies around small, stagnant pools in Georgia as offering good opportunities for experimentation.

Mr. Webster announced the inability of the committee of which he was a member to arrange for a joint session with the Society for the Promotion of Agricultural Science.

On motion of Mr. Johnson it was voted to invite the above society to meet with the Association on the afternoon of August 19.

On motion of Mr. Johnson, it was voted to attend the meeting of the Society for the Promotion of Agricultural Science from 10 to 11 a. m. August 19.

The following paper was then read:

THE PRESENT STATUS OF THE CAPRIFIG EXPERIMENTS IN CALIFORNIA.

By L. O. Howard, *Washington, D. C.*

As late as 1895 a writer in Garden and Forest (June 26) gave expression to the following statements, which appear to accurately sum up

California conditions with regard to the fig crop down to the present season:

As a commercial factor the fig has been of little importance among California fruits, although it has been an incumbent of almost every rancher's door-yard since the Padres taught their Indian peons horticulture. As a fresh fruit it is luscious and invaluable for its medicinal qualities. Eaten with sugar and cream, it is as grateful for desert as the strawberry, and more wholesome; but it is good only when perfectly ripe. It will not bear transportation under existing conditions, and the fresh figs offered in Eastern markets are a delusion and a snare. As a dried fruit it has also been a failure in the market. Quantities of dried figs are sold in California, although they are usually small and shriveled in appearance and lack the rich aromatic nutty flavor of the imported fig. The latter commands in California, as everywhere, a high price, usually 25 cents per pound. The home product sells for 10 cents. It has been the dream of fig culturists for years so to improve the quality that the California fruit may compete with the imported. To this end soils, climates, and varieties have been patiently studied.

What this says for California may also be said regarding our Southern States, except that the energetic attempts of Californians to improve the output have not been elsewhere emulated. It is now a generally accepted fact that the Smyrna fig, the fig of commerce, owes its peculiar flavor to the number of ripe seeds which it contains, and since the days of Pliny and Plutarch it has been known that in Oriental regions it has been the custom of the natives to break off branches of the wild or caprifig, bring them to the edible fig, and tie them to its limbs. From the caprifigs thus brought in there issues a minute insect which crawls into the flowers of the edible fig and fertilizes them, thus producing a crop of seeds and bringing about the subsequent ripening of the fruit. The careful investigations of Count Solms-Laubach and Fritz Muller in the early eighties, and later those of Dr. Paul Mayr have shown that the varieties of the wild or caprifig are the only ones which contain male organs, while the varieties of the Smyrna fig are exclusively female. In the caprifig there exists three crops of fruit, the first known as "profichi," the second as "mammoni," and the third as "mamme," the latter remaining upon the trees through the winter. The fig insects (the Oriental species being known as *Blastophaga grossorum* Gravenhorst) over-winter in the mamme, oviposit in the profichi, develop a generation within it, each individual living in the swelling of a gall flower (a modified and infertile female flower), and issue from it covered with pollen, from which they make vain efforts to relieve themselves, enter the young flower receptacles of the Smyrna fig, which are at that time of the proper size, and make an attempt to oviposit in the true female flowers, fertilizing them at the same time by means of the pollen adhering to their bodies, and thus bringing about an extensive production of seed. The life history of the insect from that time on is not well understood. Even Paul Mayr has failed to discover what has become of the Blastophaga during the generation of the second crop of caprifigs known as mammoni. In the development of the third or over-wintering crop, however, the Blastophaga is again present and is

thus carried through the winter in condition to oviposit in the profichi of the following spring.

As early as 1880 Mr. Gulian P. Rixford, of California, introduced three varieties of Smyrna figs and a single caprifig tree into that State. In 1885 Mr. E. W. Maslin, of California, planted Smyrna seeds taken from figs imported by the great wholesale grocery house of H. K. Thurber & Co., of New York, and presented to Mr. Maslin for experimental purposes. He grew in four years large and flourishing trees, the trunks of which had in 1889 reached a diameter of from 4 to 6 inches. In 1890 the Division of Pomology of the United States Department of Agriculture imported cuttings of the wild caprifigs from Smyrna, which arrived in excellent condition, a few even retaining and maturing fruit which had set before shipment. These immature fruits all contained caprifying Blastophagas, and the cuttings were distributed to twenty-seven persons in Florida, California, Texas, Mississippi, Louisiana, New Mexico, and Arizona, those in California at least taking root and growing with extraordinary rapidity.

Several persons in California were already, or soon after became, vitally interested in the subject of fig caprification and in its absolute importance to the fig industry of California. Dr. Gustav Eisen, at that time connected with the Fancher Creek Nurseries, of Fresno, and later curator of biology in the California Academy of Sciences; Mr. E. W. Maslin, above mentioned; Mr. J. C. Shinn, of Niles; Mr. John Rock, a well-known nurseryman of Niles; Mr. Frank A. Kimball, of National City, and Mr. George C. Roeding, of Fresno, were especially interested. Mr. Shinn, through the assistance of a missionary in Syria, imported caprifigs containing Blastophagas and endeavored to establish them, but without success. Dr. Eisen studied the subject with great care, corresponded with Count Solms-Laubach, imported with his help cuttings of a number of varieties of both Smyrna and caprifigs, and with the help of Mr. Rock, at Niles, established and has now growing several hundred Smyrna figs of large size and a number of caprifigs, while Mr. Rock has accomplished the interesting result of grafting several varieties of the Solms-Laubach cuttings of caprifigs upon a single Smyrna fig tree, thus producing a tree of great horticultural interest and possibly in the near future of much practical importance. Dr. Eisen prepared and published in 1896 an important paper, entitled "Biological studies on figs, caprifigs, and caprification," in the Proceedings of the California Academy of Sciences, Series II, volume 5, pages 897–1001. Mr. George C. Roeding, at Fresno, in the meantime had started a large orchard of Smyrna and caprifigs, comprising roughly more than 500 trees, of which about 70 were caprifigs. In 1895, through European correspondence, Mr. Roeding introduced caprifigs from Europe containing Blastophaga, but failed to bring about its establishment or even, as in former experiments, to secure the production of a single individual offspring from the imported stock on California soil.

From the beginning of the work, the United States Department of Agriculture had been thoroughly alive to the importance of the possible practical outcome. The importation of the caprifig cuttings mentioned above, in 1889–90, was done after consultation between Prof. H. E. Van Deman, then pomologist, and Prof. C. V. Riley, then entomologist, of the Department, for the purpose of establishing the proper host plants in the best possible condition in order that the subsequent importation of the Blastophaga by the Division of Entomology would have a reasonable chance of success. (See Annual Report Secretary of Agriculture, 1890, page 414.)

During the winter of 1897–98 the writer, after extensive correspondence with the board of trade of San Francisco, with Dr. Eisen, Mr. Roeding, and Mr. Maslin, decided that the time had come to make a serious and well-organized attempt to bring about the desired result. He, therefore, laid the matter before the Secretary of Agriculture and was authorized to undertake the work. He had first thought of having Dr. Eisen, so well qualified by virtue not only of his scientific attainments but also on account of his especial interest in this subject and his well-known investigations and conclusions, commissioned to visit Mediterranean regions for the purpose of collecting additional varieties of caprifigs, of sending over ripe gall figs, and of bringing to this country, if necessary, an entire transplanted and healthy caprifig tree. But it happened that about this time Mr. Walter T. Swingle, a well-known botanist in the employ of the Department, was in south Europe, at his own expense, studying at the International Zoological Station at Naples. It happened also that Mr. Swingle was greatly interested in the study of the caprifig and in the caprification by Blastophaga. It was decided, therefore, to save the expense of sending a man from America by asking the assistance of Mr. Swingle. The latter, at some personal expense, began in the spring of 1898 to send a number of caprifigs containing gall insects to the Department in Washington for shipment to California, and made a careful study of the question of the different varieties of caprifigs. In April of that year the writer, under commission from the Secretary of Agriculture, visited Mexico on an investigating trip and came northward through California, visiting all of the localities to which caprifig cuttings had been sent by the pomologist in 1890. On reaching Fresno he was at once greatly impressed by the conditions existing at Mr. Roeding's place, and with the energy, intelligence, ability, and general interest in the subject shown by Mr. George C. Roeding himself. Figs growing there, although only six years old, impressed the Eastern visitor with a belief that they could not be less than twenty years old, so extraordinary had been their growth. They were large, healthy, and luxuriant trees. Right through the center of the Smyrna-fig orchard ran a long row of caprifigs, the branches of the two varieties almost interlocking. Moreover, Mr. Roeding had planted in the foothills of the mountains, some miles away, other capri-

fig cuttings in order to simulate as nearly as possible the climatic conditions under which the caprifig grows most successfully in the Orient. Communicating with Washington, the first shipment of caprifigs from Mr. Swingle fortunately arrived at Fresno while the writer was there. They had been sent from Naples, the locality in which Dr. Paul Mayr had made his studies. Mr. Swingle had adopted an ingenious and eminently successful method of packing. Each green caprifig was carefully and closely wrapped in tin foil, the end being covered with wax. On arrival at Fresno the female Blastophagas were seen to be emerging from the gall figs. Unfortunately, however, with them were a number of specimens of *Philotrypesis caricæ* Hasselquist, the one figured and described by Paul Mayr as *Ichneumon phycarius* Cavolini. Mr. Roeding readily distinguished between the female Blastophaga and this parasite and destroyed all the parasites noticed. By the writer's advice a caprifig tree was inclosed in a thin cloth tent and subsequent sendings of caprifigs were placed in this inclosure and the Blastophagas were liberated.

Then a year elapsed without result. None of the caprifigs on the inclosed tree were stung by the Blastophagas, or if stung no larvæ developed so far as Mr. Roeding could observe, although subsequent developments would seem to indicate that there is a possibility of a partial establishment of the species from the spring of 1898.

In the meantime Mr. Swingle had been transferred to the section of seed and plant introduction of the Division of Botany, and commissioned as an agricultural explorer to work on the introduction into the United States of desirable plants, with all traveling expenses paid. In the course of his work he went to Greece, and from there sent additional varieties of caprifigs to this country, which were forwarded to Mr. Roeding and planted under differing conditions.

In the winter he went to Algeria and sent other cuttings and one large caprifig tree 10 feet or more high and perhaps 4 inches in diameter. This was also sent to Mr. Roeding, and, although the long journey had apparently reduced its vitality so much that Mr. Roeding feared that it would not live, it was planted, and at latest advices is in excellent condition. As the spring opened Mr. Swingle again began his sendings of the gall figs, packed as before, and which as before were placed by Mr. Roeding under the artificial inclosure. On March 31, 1899, six boxes of caprifigs were received by the writer and forwarded to Mr. Roeding; on April 5 one more box, and on April 6 the eighth and last. On April 6 the first boxes were received by Mr. Roeding. The fruits seemed to be in excellent condition. He cut several open and found them full of Blastophagas in the pupa condition. All of the figs were cut open and placed under the covered tree.

It must here be said that none of the persons connected with the work had much hope of the establishment of the fig insect by this method on account of previous failures. It was tried because the oppor-

tunity offered and because of the variations referred to in the method of packing and the careful tenting of the single tree, in the hope that some might succeed in finding fruit of the right size for entering and for oviposition. Mr. Roeding, in acknowledging the receipt of the sending of March 31 and promising to cut them open and put them under the covered tree, said: "But I anticipate no results, and I do not think a success will be made of this matter until fig trees with the figs attached are sent out here during the winter months." Most of the figs shipped from Washington on the 5th and 6th of April arrived at Fresno in a decaying condition.

In view of everything which has so far been said in this paper, the pleasure of the writer on receiving the following telegram from Mr. Roeding will readily be understood:

FRESNO, CAL., *June 23, 1899.*

Dr. L. O. HOWARD,
Chief Entomologist, Washington, D. C.:
Great surprise. Blastophaga developed in caprifigs. Send instructions.
GEO. C. ROEDING.

This was followed on the next day by the following dispatch:

FRESNO, CAL., *June 24, 1899.*

Dr. L. O. HOWARD,
Chief Entomologist, Washington, D. C.:
Twenty figs tented tree; insects pupa state; one fruit outside; winged insects now escaping; fruit hanging Smyrna tree; letter and fig mailed.
GEO. C. ROEDING.

The letter referred to contained the interesting statement that the figs with the insects in them were discovered by accident. One of Mr. Roeding's men was engaged in gathering caprifigs and extracting the pollen for the purpose of artificially pollinating Smyrna figs by means of a blowpipe. He ran across one fig which apparently contained seeds, but which Mr. Roeding found were in reality galls. The fig was taken from the covered tree, and about the 24th of June all of the figs on the same tree had dropped and shriveled up, with the exception of about twenty, which were still green and plump, and which subsequent evidence showed contained developing Blastophagas. Another fig outside of the covered tree was found later in the same day, from which a winged Blastophaga was in the act of emerging. This fig was immediately tied on one of the Smyrna fig trees. A day later ten more figs on an outside tree were found to contain the Blastophaga. The penetrating power of the female Blastophaga was shown by an interesting experience of Mr. Roeding. On June 29 he picked half a dozen caprifigs and, placing them in a glass jar covered with cheese cloth, started for his foothill farm, where he has some caprifigs growing. On the journey about one hundred Blastophagas emerged, and were quite lively, flying around in the jar. On arrival he found upon examining the cheese cloth that at least a half dozen of the insects were forcing their way through the cloth, and some were crawling on the outside.

On June 29 all the wild figs left under the tented tree and those on the outside tree, with the exception of one, were picked and hung in other wild fig trees upon which young fruits, presumably mammoni, were beginning to develop. On the 30th of June a most interesting discovery was made. A tree 1,500 feet away from the tented tree was found bearing two caprifigs containing galls and male insects.

About the middle of July Mr. Roeding found Smyrna figs which had been fertilized by the Blastophaga. By July 19 not only was the difference between these figs and the unfertilized Smyrna figs most striking, but the difference between them and those which had been artificially pollinated was also very marked. The unfertilized Smyrna fig is hollow, can easily be squeezed together by the fingers, and drops to the ground before it is more than three-fourths of an inch in diameter. The figs which Dr. Eisen and Mr. Roeding have been able to artificially fertilize by collecting pollen from the caprifigs and introducing it into the orifice of the Smyrna fig by means of a toothpick or blowpipe become rather firm, and on reaching maturity contain many ripe seeds, probably not more than half, however, of the number of ripe seeds that may be found in the average imported Smyrna fig. Those found by Mr. Roeding which had been pollinated by the Blastophagas, however, were by the 19th of July more than twice as large as the unfertilized ones, were solid and firm, and literally packed with ripe seeds surrounded by tissue of a beautiful pink color. On the same date (July 19) caprifigs were found full of what seemed to be galls. Dissection, however, showed that all of the seed-like objects which were cut open were really seeds and not galls. The precise variety of caprifig in which this phenomenon was noticed is not known to Mr. Roeding. It contains male flowers, however, and is with little doubt a caprifig. The mammoni flowers, as is well known to investigators, occasionally develop a certain number of ripe seed.

What the outcome will be from this time on is difficult to predict. The Blastophaga has been successfully introduced and has bred profusely for one generation. Whether it will breed in the mammoni caprifigs we can not tell as yet. It has not been found to do so in Europe, as previously stated. The third crop of caprifigs in Mr. Roeding's home orchard, near Fresno, invariably drop during the winter, but he has found that in caprifigs growing at his foothill place the figs hang on during the winter. He has made every effort to introduce Blastophaga at that place also, and it is very possible that the insect will successfully hibernate there, if it does not do so at the valley place. There is even a strong possibility that no more importation may be needed. There is also a possibility that the insect will die out owing to variation in season of blooming of the caprifig, and owing to the fact, perhaps, that the right varieties are not growing at Fresno. The present year's experience, however, has shown that the insect can be brought over

and can establish itself. We know the proper date and we know where to get the Blastophagas at the proper date. Thanks to Mr. Swingle's idea of sending over the mamme, or over-wintering caprifigs, instead of those of the profichi or spring crop, which were the ones invariably sent in the earlier private attempts which we have mentioned, and thanks also to his excellent method of packing, the successful introduction for a season at least may be repeated indefinitely and with certainty. Efforts will now be made to introduce and to grow in different parts of California every possible variety of caprifig, and it is safe to say that what once seemed so difficult, if not improbable of accomplishment, is now comparatively certain, and there is every reason to believe that in the near future California will be growing and marketing dry figs which will rival the commercial product of Oriental regions.

In discussing this paper Mr. Marlatt called attention to the far-reaching effects that would follow the introduction of this insect should it prove entirely successful. The success of this undertaking would be of an importance to the fruit growers of California paralleled only by that attending the introduction of the Vedalia to prey upon the fluted scale.

Mr. Hopkins felt that the success of Mr. Howard's efforts would be a source of great pride to all American entomologists.

Mr. Johnson spoke of the great opportunities in California for fig growing and that the lack of the fig insect had until now blocked the progress of this industry. If this importation proves successful, it will be one of the greatest events in economic entomology.

Mr. Osborn saw in this undertaking an excellent illustration of the far-reaching results that ultimately attend patient, persistent scientific effort.

Mr. Webster emphasized the entomologist's need of knowledge of the conditions under which imported fruits were grown in their native lands. That such a great piece of entomological work should be done in America must ever be a source of pride to all working entomologists.

In connection with the necessity of knowing the conditions under which plants are grown in all parts of the world in order to appreciate the damage from insects and the value of means of control as alluded to by Mr. Webster, Mr. Marlatt called attention to the very large foreign membership of this Association and the fact that the economic entomologists the world over were closely allied in interests and had a minute acquaintance with the work that each is doing, and that perhaps in no similar world association was there a more complete union of interests and knowledge of the work done than in the Association of Economic Entomologists.

The next paper was read by Mr. Howard:

THE ORIGINAL HOME OF THE SAN JOSE SCALE.

By L. O. Howard and C. L. Marlatt, *Washington, D. C.*

The suggestion that Japan may be the original home of the San Jose scale has been made several times in the last few years and has come to receive a fairly general acceptance. How positively this claim has been put forth is shown in the suggestive and interesting paper entitled "Some Economic Features of International Entomology," by Mr. F. M. Webster, published in the Annual Report of the Entomological Society of Ontario for 1898, in which he uses the following words: "The San Jose scale * * * is in all probability another contribution from the Palæarctic region, as I have been able to prove almost conclusively that it came to us from Japan." The object of the present paper is to bring together the evidence on which this belief rests, and to determine the value of this evidence.

It will be remembered that the detailed bulletin on this insect, prepared by the writers and published as No. 3, New Series, Division of Entomology, U. S. Department of Agriculture, the subject of the origin of the San Jose scale was fully discussed, and after showing that the theory that it is native to either Chile or Hawaii lacks basis, the conclusion was reached that, while the insect might prove to be indigenous to Australia, it may also have come from Japan, China, or some other portion of eastern Asia, or perhaps from some of the islands in the Pacific.

In discussing the possibility that Australia may be the original home of this pest Mr. Maskell was quoted as expressing the belief that this insect was introduced into Australia from Japan. His reason for this was the rather insufficient one that within the last few years many Japanese fruit trees have been imported into Australia. In view of this possibility, Mr. Koebele, on starting for Asia in 1895, was requested by one of us to make a very careful examination for this scale in the course of his work in both Japan and China. Mr. Koebele, as every one knows, is one of the best of collectors and observers, and was perfectly familiar with this and other scale insects, yet after all of his efforts he returned to Hawaii and reported that he had been unable to find the San Jose scale either in Japan or in China. Moreover, Mr. Otoji Takahashi, a skilled entomologist who had studied scale insects under Comstock at Cornell University, was commissioned by the Division of Entomology, U. S. Department of Agriculture, in the fall of 1892, to collect injurious insects in Japan. He collected a number of scale insects, but in no case did he find the San Jose scale. Down to this point, therefore, evidence in favor of Japan as the original home is entirely lacking.

In Bulletin No. 6, Technical Series, of this Division, The San Jose Scale and Its Nearest Allies, Professor Cockerell expresses the opinion

(p. 14) that *Aspidiotus perniciosus* is, with little or no doubt, a native of Japan, basing this conclusion on the fact of the discovery on stock from Japan of two varieties or subspecies, viz, *andromelus* and *albopunctatus*, and furthermore on the statement of Mr. Alexander Craw that the only time that he had found *perniciosus* on imported stock was on some apple trees from Japan the grafts of which were purchased in America. The latter basis for the belief in the Japanese origin of this scale would seem to be rather feeble, but the occurrence of the two varieties mentioned is stronger evidence, especially in view of the fact that they can not be considered varieties at all, but should both be referred to the San Jose scale, from which they were separated on imaginary differences in the covering scale.

The subject is again taken up by Professor Cockerell in Entomological News (April, 1898, p. 95), and the statement is made that Mr. Craw reports finding this scale two or three times on trees from Japan, and it is suggested by Professor Cockerell that the scale is probably a native of the more or less elevated forest regions in Japan rather than of the seacoast strip, which, as a rule, is characterized by oriental or tropical species of scale insects.

Additional evidence pointing to Japan as the home of this scale is given by Professor Webster in Bulletin No. 103 of the Ohio Agricultural Experiment Station, page 196. Professor Webster reports finding in April, 1898, this insect associated with the peach scale, *Diaspis pentagona*, on Japanese semidouble flowering cherry received direct from Japan during the winter of 1896–97, the nature of the infestation and the isolation of the place in which the trees were planted proving their infestation when received. A lot of similar stock belonging to the same varieties, and imported directly from Japan during the winter of 1897–98 by the same firm, was examined and a similar infestation with the San Jose scale was discovered, especially on the old stocks or stumps. In the same place Mr. Webster quotes Mr. Walter W. Froggatt, government entomologist for New South Wales, to show the latter's belief that the San Jose scale came to Australia from Japan, citing three instances mentioned by Mr. Froggatt of direct importation of stock infested with this scale. This is confirmatory of the similar evidence given much earlier by Mr. Maskell.

During the present year the Department of Agriculture has three times determined this scale insect on material received direct from Japan, the most interesting instance being in connection with a large lot of plums collected in Japan for the Department of Agriculture by Mr. Knapp. These trees were all more or less infested with the pernicious scale.

A very interesting account of the occurrence of this insect in Japan has just come to us from a student of entomology, Mr. M. Nawa, writing from Kyomachi, Gifu, Japan, under date of June 2, 1899. His deter-

minations have been confirmed and his rather quaint English is quoted *verbatim et literatim*:

There is no investigations of these insects in my country yet, I ever send a specimen of this insects to Mr. S. I. Kuwana, a Japanese student at the University of Stanford, California, and it was reported that that insect is San Jose scale, which remaind carelessly in my country.

To my observation it lives not only on the branches of pears and apples, but on the barks of plum trees, *Prunus communius* Per., *P. cerasus*, L., *P. persica* var. *vulgaris* and wild *Cydonia japonica* Pers. (*Rosa*). But they do not flourish so much on the trees last mentioned as on the trees of pears and apples. Indeed its investigation is very poor in my country, its destructive power remained unascertained. I caught some of them and cultured carefully. On the 15th of April, male insects became pupa and in the last part of the month, they took wings and walked on the barks, and on the 1st of May I saw a bee, of which is supposed to be a parasite of this San Jose scale. I am now investigation it. And it was observed that a genus of Coccinella Coleoptera devours it, so Coccinella is one of protective insects which destroy this enemy.

There is, then, ample evidence to show that the San Jose scale at the present day occurs in Japan, and that it has been sent from that country not only to America, but also to Australia. The fact remains, however, that prior to 1897 the species was not found coming from Japan, although Mr. Craw had been at that time examining shipments of live plants from that country for some years. Were it not for the fact that we know the point of origin in this country to be on the grounds of a man who was an extensive importer of plants—viz, Mr. James Lick, of San Jose, Cal.; and were it not for the further fact that the spread of the insect has been so carefully studied and well recorded in America, there would be no more actual evidence that Japan is the original home of the San Jose scale than there would be in the minds of Europeans that America is its original home. European observers find San Jose scale on cuttings and fruit coming from America; we find the same thing on cuttings coming from Japan. The cases are identical, with the exception above noted. When we consider the very significant fact that Japanese importers have been getting from America apple cuttings and buds, and pear cuttings and buds rather extensively in the past few years, and that many of these have come naturally from California, Oregon, and Washington, is it not, after the statement of the evidence which we have given, quite as reasonable to suppose that Japan received the San Jose scale from America as that America received it from Japan? We are rather inclined to think that so far as mere evidence goes the first supposition is more reasonable than the second. We are of the opinion that the matter rests practically as it did when our bulletin No. 3 was written. Japan may be the original home of the species on the theory suggested by Cockerell, that it may occur only in the higher regions and not on the seacoast. Further investigation must be made before any such statement should be accepted as the one quoted in our opening paragraph: "I have been able to prove almost conclusively that it came to us from Japan."

Mr. Webster called attention to the fact that, while Mr. Koebele failed to find the San Jose scale in Japan, it might still exist there, although well checked by its natural enemies. From examining infested Japanese nursery stock he had gained the impression that the trees had been infested for a long time. In his opinion the strongest evidence was in favor of the Japanese origin of this scale.

Mr. Johnson's views coincided with those held by the authors of the paper. He felt that it was quite probable that the scale was carried to Japan from America. It was noteworthy that injury by the scale was declining in California. In Maryland also it appeared that there were local checks upon the increase of this species, and the case of an infested orchard in Dorchester County was cited, where 98 per cent of the scales were found to be dead.

Mr. Howard said that California conditions as regards the San Jose scale have not been accurately stated. General statements have been made which cover the whole State, whereas, while the scale has undoubtedly died out in certain regions, as notably around San Jose, Cal., where it was originally found, he had seen orchards in southern California as late as May, 1898, where the scale was as abundant and as destructive as he had ever seen it in Maryland.

Mr. Marlatt stated that he also had noticed the almost complete disappearance of the San Jose scale from orchards at San Jose, Cal., where it had first appeared, as described by Dr. Howard, and expressed the belief that the time was not far distant when the San Jose scale would be not much more feared than other common scale pests of fruit trees.

Mr. Webster thought it was significant that the scale was not injurious in Japan. This would not be the case if the pest was first carried there from the United States.

Mr. Howard expressed the opinion that as yet it was too early to judge of the economic status of the scale in Japan. It might prove injurious in that country in the course of a few years.

Mr. Osborn called attention to the necessity in the present case of keeping in mind the distribution of the closely allied members of the genus. He inquired concerning the original home of *Aspidiotus ancylus*.

Mr. Kirkland mentioned finding *Pyrus americana* generally infested with *ancylus* in the Lobster Lake (Me.) region, some 10 miles from settlements and where the chance of its introduction by man was improbable. He also saw in the well-known resistance of the Japanese quince to the San Jose scale an argument in favor of the theory that the scale was a native of Japan.

The following paper was then read:

VOLUNTARY ENTOMOLOGIC SERVICE IN NEW YORK STATE.

By E. P. Felt, *Albany, N. Y.*

Though it is no new idea to have a corps of observers located here and there at favorable points, I have no knowledge of its being applied

on a scale of any magnitude by entomologists. The experience of the present season, which, by the way, is not ended, is presented at this time to call attention to its capabilities, and also for the purpose of eliciting criticisms and suggestions from fellow-workers. The establishment of this corps of observers had in view several objects: First, to bring the office into closer relations with the public; secondly, it was very desirable to receive regular reports from different sections of the State, and in doing this we ascertained how things appeared to the individual, who in many cases was a practical man of affairs, and in a great number of instances was directly connected with agriculture in some branch or other. It was not expected that it would be possible to find readily a sufficient number of persons who would be as well qualified for the work as though they had been trained entomologists; hence we have also aimed to educate the voluntary observers to some extent, and also to reach others through them. This is being accomplished by sending to the observers special directions whenever necessary by supplying them with all entomological publications issued by the office, naming insects for them, and by answering inquiries freely. While the work was undertaken for but one year, it is hoped that it will be continued, and that the mass of data being collected from all sections of the State will, in the course of years, throw considerable light on the causes controlling the abundance of insects and their distribution, and those leading to a modification in habit or a change in life history. With this latter in view, the voluntary observers were instructed to include in their reports all data relating to insects, especially those of economic importance.

A circular letter was prepared in the winter months and sent to parties in all sections of the State. It outlined the work as follows:

To all interested in entomology:

New York State with its enormous and varied agricultural interests suffers immense losses yearly from the depredations of insects. Its large area renders it impossible for one man, or even a moderate force of men, to observe properly the many insects within its borders and warn the inhabitants of threatened loss by their attacks. In order to bring this office into closer relations with the public and render it of greater practical value, it is desired to establish an auxiliary force of voluntary observers who will serve without pay and send short reports to the State entomologist weekly during the growing season and less frequently at other times. Though few entomologists will be able to take up this work, many valuable facts regarding the relative abundance of insects, the extent of their depredations, the effect of climate, soil, and altitude, the distribution and spread of insect pests, etc., may be collected from all sections of the State. As necessity arises, directions will be issued in regard to what insects should be looked for and where the observations should be made.

Voluntary observers will be appointed by the regents on the recommendation of the State entomologist, and will receive copies of future State entomologic publications. Each person will be given due credit in these publications for all his observations and contributions of specimens, and in the course of a year should learn many valuable facts, as all inquiries for further information concerning an insect or in regard to its identity will be cheerfully answered. Those wishing to join in this volunteer service are respectfully requested to communicate at once with the under-

signed, and, as an earnest of what may be expected in the future, to send in a few of their more important observations on insects of last year. All observations should be recorded, as they are always of value and the absence of records is difficult to supply in later years. Soon after the appointments are made, appropriate stationery will be sent to those selected.

The plan offers present correspondents the advantage that it will systemize their work and increase the interest of all in the important study of applied or economic entomology. If the recipient of this communication does not care to undertake personal observations, he is requested to place it in the hands of one who will be interested in taking part in the service.

It was the intention to have approximately one observer in each of the sixty-one counties of the State, though it was by no means expected that every county would be represented. From the list of applicants the appointment of thirty-nine persons, representing thirty-three counties, was recommended on April 19. This number was augmented by the subsequent appointment of eight others, and in turn was reduced by the resignation of four. One resigned on the receipt of the stationery, on account of its appearing too official. Another was forced to give up the work before its inception because of a severe illness, and two others found themselves unable to comply with the requirements from pressure of other duties. On May 16 a circular letter, with copies of Bulletin 26, was mailed to forty-two observers. The following extracts from the letter are given for the purpose of showing the general scope of the work:

To voluntary observers:

It is not expected that many will have time to prepare long reports. I desire specially to gather in brief form the observations and experiences of practical men with insects. Under no circumstances omit the weekly report during the growing season, for even negative results have value. It is most desirable that the reports should be regular and received in Albany about the same time, so that they may be collated and the more valuable facts made known. For this reason each observer is urged to mail his report every Wednesday or Thursday in order that it may be received at the office on Friday of each week. Ten stamped envelopes with paper are sent herewith and more will be supplied as needed.

The matter of more general interest in the reports will be brought together in brief form and supplied to agricultural papers, each observer receiving full credit for his work. For the most part give attention to species of economic importance, such as those injuring plants of value, annoying live stock, or proving a nuisance in the household. Inquiries regarding insects will be welcomed and answered as fully as practicable. In most cases the reports will be more valuable if accompanied by specimens of the insect or its work, preferably both. Useful hints for collecting and observing insects will be found in Museum Bulletin 26, mailed under separate cover. The species mentioned under "Distribution of insects" are of special interest and should receive close observation from every fruit grower and farmer.

Finally, do not become discouraged if at first there appears little that is new or of interest, but record what is seen, because one object of this organization is to ascertain actual facts regarding insect life. In time the eye will become trained and many things hitherto unnoticed will be observed and much of this will be of considerable value, not only to the scientist and the public, but to the observer. Though the appointments were unfortunately delayed longer than was desired, it is a decided advantage to begin such work when there is plenty to see.

In work of this nature it is difficult to make definite statements regarding the value of the service. At the present time there are forty-three observers on my list, representing thirty-nine counties. Summarizing the work to Saturday, August 12, a total of 200 reports have been received, a little over fifteen for each of the thirteen weeks, or an average of five for each observer, if we deduct the names of three who for some cause have failed to send in one report. On looking over the record it will be found that three observers have submitted but one report during the season, four two reports, four three reports, and six four reports. Though these numbers are low for a period of thirteen weeks, it must be remembered that this is a voluntary service on the part of the individual, and in some instances was undertaken simply to help along what was regarded as a good work. During this period some have been ill; others have changed their plans, and found themselves away from home much more than was expected in the early spring. A few have sent in reports only when they saw something, and from certain localities I have been assured that no injurious insects have proved troublesome. While an entomologist who had the training and leisure to look for insects would find much of interest, the case is by no means the same when a busy man undertakes the task with little or no previous training. While a number have sent in relatively few reports, others have been most faithful and have proved themselves valuable agents. Two observers have not failed to submit the weekly report, two missed but one week, and three sent in nine reports. As is well known to naturalists, the value of the report lies in its contents and not in its length. In this respect most of the reports have averaged very well, while those of a few observers could hardly be improved. Abridged summaries of the reports received from the voluntary observers have been printed weekly in the Country Gentleman, published at Albany, and almost weekly in the New York Farmer, published at Port Jervis. Copies of these summaries were sent to several other agricultural papers having a circulation in New York State, but as they did not care to use the matter they were dropped from the list.

In summarizing it will be interesting to see how the establishment of the organization has accomplished the desired ends. The correspondence of the office has been very much larger the present season than in any other since my connection with it. Some of this was undoubtedly due to other causes, but a considerable proportion, aside from that with the observers themselves, I attribute to the activity of the voluntary observers in advising others where to apply for information. One man I know of has been particularly active in this respect. It has been a source of gratification to note that almost every outbreak in the State has at some time or other been brought to my notice through the voluntary observers, even though my first knowledge of it may have come through other channels; and I must also add that in every instance the reports of these agents have been conservative and

trustworthy, so far as I know. The observers are getting hold of the idea much better than early in the season, and some of those who hardly knew what to report at the beginning of the season are now doing good work. It is yet early to state much as to the value of the reports in settling questions regarding the influences affecting insects; that can be determined only by observations extending over a series of years. But from what I have at hand it seems very probable that our expectations will not be disappointed in this respect. Taking everything into consideration, I feel that the establishment of a voluntary entomologic service in New York State has been a benefit to the science, and that it has already accomplished a good work and gives promise of a bright future.

Mr. Webster stated that in Ohio he had adopted the plan of encouraging intelligent observers to correspond with the experiment station, and had succeeded in most cases in retaining their assistance by sending them duplicates of bulletins, reports, etc. In this way a set of valuable local information bureaus had been established.

Mr. Johnson had found a similar system productive of good results in Maryland, attention being paid more especially to officers of horticultural societies.

Mr. Johnson then presented the following:

THE EMORY FUMIGATOR: A NEW METHOD FOR HANDLING HYDROCYANIC-ACID GAS IN ORCHARDS.

By W. G. Johnson, *College Park, Md.*

After my experience with the canvas tents in handling hydrocyanic-acid gas, in 1897 and 1898, while I was confident it could be used to good advantage in bearing orchards, I was satisfied the method would have to be simplified before it could be used by the average orchardist. The main difficulty was in the calculation of the cubic contents of a tented tree and the measurement of the chemicals afterwards. The folds in a tent over a tree are so extremely variable, it is almost impossible to calculate the cubic contents even approximately. As the success attained by this method depends entirely upon the exactness with which the operation is performed, it was therefore necessary to find a system less variable.

First of all, we wanted a method by which we could keep the cubic contents nearly constant; second, one that could be applied without the constant wear and tear upon the tree by the tent, resulting in the destruction of so many fruit and leaf buds. After much thought and consideration we decided that both objections to the old tent system could be overcome by the construction of a box with a square base, varying in height to suit conditions, and having a canvas hood. We also had another object in view, and that was the cheapening of the

cost of the equipment, as the first cost of a sheet tent was about $18, which was beyond the means of most fruit growers. We decided to construct our first experimental boxes out of paper.

Light wooden frames were constructed and covered with heavy rawhide building paper. The largest box was 6 feet square at the base and 8 feet high (as shown in the photograph). It was put together by means of 3-inch butt hinges, and could thus be easily opened by drawing the butts from one side. The hood is made of 8-ounce U. S. A. duck, and is 6 feet 4 inches at base, 4 feet square at top, and 7 feet high. It is kept in place by means of cleats around the top of the frame.

The hood is first put in place over the top of the tree, after which the frame is drawn around and closed (as shown in photograph). After the bottom of the hood has been securely fastened to the top of the box and a little dirt has been thrown around the bottom the frame is tipped back slightly and the chemicals introduced. At the expiration of from thirty to forty-five minutes the hood is removed, box opened, and slipped around the next tree.

Boxes under 6 feet in height were constructed without hoods and the sides were screwed together. These can be handled easily and can be used on small trees, where it is not practicable to use the tent.

We used this method successfully last fall fumigating a block of Buffum and Lawrence pears infested with the San Jose scale. It was slow work, however, as it was somewhat troublesome to place the hood, arrange the box, and get it ready for work. The system, however, was as near perfect as we could expect to get it, and we began work to overcome the two serious objections. First, we wanted a box with a permanent hood, and, secondly, one that could be handled without being opened on the sides. At the same time, while we found the rawhide paper perfectly satisfactory on the large box, it was quite troublesome to put it on the frame smoothly. The edges were first glued and then nailed. It was also easily punctured by a broken limb unless great care was taken. This last point was not a serious objection and we had little or no trouble. A material, however, with more elasticity was desirable.

Taking all these points into consideration, we constructed a box of the same dimensions as the paper box, covering it with 8-ounce ducking, screwing the sides together, and fastening the hood on permanently by means of narrow strips screwed to the top of the frame.

Having completed this box, there arose the most serious obstacle that had yet confronted us. How were we to handle a box of such dimensions with permanent hood and sides? There was only one way to do it, and that was to pick the box up and lower it over the top of the tree. This we accomplished by means of a 35-foot mast made of spar pine, cut from the woods near by, and a 12-foot gaff of the same material, fitted with ropes and pulleys and rigged to the running gear of an ordinary farm cart. By means of this we could raise and lower

the box fumigators over any tree varying in height up to 17 feet. The system worked perfectly, and we were pleased beyond our expectation. We applied it to a block of infested pear trees the first and second weeks in April this spring.

It requires three or four men to operate an outfit of this kind, the help, of course, depending upon the number of fumigators in use. It requires one man to look after the chemicals and time, and two or three to handle the fumigators and rigging. With an equipment of ten fumigators this force under favorable conditions could in one day fumigate from 175 to 200 trees from 12 to 17 feet in height.

The cost of the chemicals is about 4 cents for the 8-foot box without the hood extended; 5 to 6 cents when the hood is half extended; 6 to 7 cents fully extended. The cost of whale-oil soap for spraying trees would be from a third to a half more, while 30 to 50 per cent kerosene would about equal the cost of the chemicals for gas.

The cost of the large fumigator complete is about $12, or just two-thirds that of a 25-foot sheet tent sufficient for covering a tree the same size. The rigging for handling the fumigators costs about $12. Taking it all in all, this system is simple and can be used by the average orchardist.

In reporting this method for handling hydrocyanic acid gas, I desire to say that I have had the practical experience of my friend, Capt. R. S. Emory, of Chestertown, Md., without which it would not have been possible for me to have completed these experiments. The equipment was furnished me by the State horticultural department and the experiment station, but the mechanical details were under the personal supervision of Mr. Emory. I desire to name this the "Emory fumigator," therefore, in his honor, as a slight recognition of his services and practical experience.

Mr. Webster inquired as to the possibility of securing the entire extermination of the scale in an orchard.

Mr. Johnson stated that such an attempt was impractical in large orchards, but that the scale could be controlled by fumigating a part even of the trees in alternate years in cases where it would be impossible to treat an entire orchard in a single season.

Mr. Webster recalled fumigating a quantity of infested stock which was wet and partly covered with mud at the time of treatment, yet all the scales were killed.

Mr. Johnson's experience in treating wet nursery stock was contradictory to that of Mr. Webster, and he had thought the failure of the process to be due to the affinity of hydrocyanic acid gas for water.

Mr. Marlatt called attention to the great value of Mr. Johnson's work in developing a practical method of fumigating orchard trees. The problem at the outset was surrounded by many difficulties, but Mr. Johnson had boldly attacked it and reached a satisfactory solution.

The following paper was then presented:

INSECTARY AND OFFICE METHODS.

By F. M. Webster, *Wooster, Ohio.*

It is my intention to give an idea of the methods in use in the entomological department of the Ohio Agricultural Experiment Station. Under insectary methods, I have included all matters relative to collecting and rearing of insects, while under office methods I have grouped the management of this material after it is mounted, together with record keeping, mapping areas of distribution and in fact, everything relating to each species, until it reaches the permanent collection, and the records connected with it are published.

I might, perhaps, say that while in the beginning our system requires a considerable expenditure of time, we have found that when we come to use the notes, records, and material, and especially if these were required on short notice, we save vastly more time than was consumed in the inauguration of the system. Where a single person is working alone and is personally familiar with every specimen that is connected with his investigations such a system may not be necessary, but where there is one or more assistants, there must be some method employed whereby each will understand at a glance what the other has done, and the records be as intelligible to one as they are to another.

Regarding the material that comes into the insectary, this is, of course, derived from two sources: First, that of our own collecting, and which may come from all parts of the State, and second, that which is sent to us by correspondents, and which comes largely from the State in which we are located, but may come from almost anywhere. For such insects as do not require leaf plants upon which to feed, or such as have passed into the pupal stage and require no food, excepting such insects as are found in limbs and trunks of trees, we manage by the old method of placing them in jelly glasses. For such as require a limited amount of food, and especially where we wish to watch their movements very closely, we use the ordinary glass cylinders known as chimneys for the Argand gas burners. These are about two inches uniform diameter and five inches in length. We find these preferable to ordinary lamp chimneys, as they are of better quality of glass and less easily broken. These can be placed over plants, either in the benches, in the insectary, or when the plants are growing in ordinary flowerpots. The top of the cylinder is covered with a thin muslin and held down with glue or asphalt. Whatever preparation is used for this purpose should be insoluble in water. For insects that require much food, and for which a large amount of leafage is consequently necessary, we employ larger breeding cages. These have been fully described in my paper on a "Serviceable insectary," published in the Canadian Entomologist, volume 31, pages 73–76, and I will, therefore, not redescribe them here, but refer to this publication for a full descrip-

tion. We have certainly found it much more satisfactory to transplant food plants to the benches of the insectary, and better yet, where possible, to grow these plants in such situations, as the food supply for the insects is thus in a more natural condition than can be made possible if the food is simply gathered and placed in the old-style breeding cage with an immovable bottom. Where possible to do so, I make it a point to grow food plants in the insectary, and thereby prevent the accidental introduction of forms into our breeding cages which very often are exceedingly annoying, and nearly or quite vitiate results that have cost much time and attention.

When material is brought into the insectary, it is seldom given an "accessions catalogue" number at first, but is placed in jelly cups and a slip is attached to the cup, giving date of reception and locality from which it came. In case nothing develops worth recording, then we have saved loading down our accessions catalogue with unnecessary numbers. But as soon as any developments are noted, as for instance the appearance of parasites, or the further transformation of any of the insects included, we then enter the material in the accessions catalogue, number it, and attach this number to the cup or breeding cage, as the case may be. The only drawback to this method is that, where we have a miscellaneous lot of material, as for instance a number of parasites coming from the same host, as soon as the different species are determined, we have to take these out from the original number and make a special number for them, referring back on the accessions catalogue to the number from which they were taken, or under which the material was originally placed. Up to the present time I have seen no way of avoiding this, although it is possible that some other more practical method may be devised in the future. As soon as material is taken from the cages or from the jelly cups it is pinned, and a label placed upon each pin, giving date of appearance and accessions catalogue number. If the material has come from elsewhere besides the experiment station, or immediate vicinity, the exact locality, as nearly as we can obtain it, is indicated on the pin, on the second label. That is, we would have on one label "Insectary, 6–5–'99," which signifies that the specimen appeared June 5, 1899. Either below or above this label would be another, which might read "Toledo, O., 1–4–'99," which would indicate that the material from which the specimen developed was obtained at Toledo, on the 4th of January, 1899. This prevents the confusion between the date of collection, and the date of appearance of fully developed specimen. If, as is sometimes the case, material is placed out of doors and there reared in breeding cages, we then give the original locality and date of collection on one slip and on another the locality and date where it was reared, so that there will be no confusion between the two. In regard to pinning, we follow the methods generally in use among American entomologists, and I might add that we are, in common with nearly everyone else, wrestling with the problem of how best to arrange alcoholic material. At the

present time we are using small wooden racks with wires stretched across to hold the vials in a vertical position, but frequently they fail to accomplish the purpose; the method is not at all satisfactory, but simply the best that we have been able to find up to the present time. It is expected that breeding cages and breeding cups will be carefully inspected, at least once each day, and everything that has reached a condition where it is ready for permanent preservation is removed, although it frequently occurs that cups may have to be examined several times each day in order to prevent insects which are developing in them from becoming rubbed or otherwise injured by attempts to escape.

For the rearing of such insects as bore in wood, and their parasites, we have had a special cage made. This is much like the ordinary breeding cage, except that the top, bottom, and three sides are of wood. The fourth side is provided with a movable front, and for this we use a very heavy glass, very thickly painted with asphalt, so that after we have placed sections of limbs of trees in the cage and closed the front, the interior of the cage is entirely dark, excepting a very little light that is permitted to enter from a round hole made in the top of the cage, and over this we place one of the glass cylinders, previously named, the top of which is covered with muslin, as has been described. These glass cylinders are held in place by small spiral springs made of brass wire, and arranged in such a way as to inclose the lower end of the cylinder about an inch from the end, the springs being held in place by small nails. By this means all insects that develop in the cage below on seeking the light make their way upward out of the cage and into the glass cylinder from which they can not escape, but wherein they may easily be detected. When we wish to remove them we simply raise the cylinder slightly and push a bit of cardboard beneath it, thus shutting off the escape of the insect, and, by injecting a few drops of chloroform into the cylinder and covering the top, kill them almost instantly without in any way affecting the atmosphere in the compartment below. These cages are quite convenient, as they may be placed almost anywhere on a shelf or similar place, and it is only necessary to inspect the glass cylinders in order to determine whether or not anything has developed from the sections of wood beneath. For setting boards we have not found anything better than the one made of wood, 8 inches to a foot in length, and of different widths, grooved through the center and punctured for the reception of pins with cork attached to the under side. For holding pins in a convenient position for use, we use a block of wood with holes very much of the style recommended and figured by Dr. E. P. Felt in his Bulletin, No. 26, on "Collection, Preservation, and Distribution of New York Insects," page 14, figure 14, except that we have found it much more convenient to attach this block firmly to the end of a sheet of cork, as this not only places the pins in a convenient position, but the cork extending out from below the block is exceedingly handy for placing pinned material, after the

insects have been pinned or gummed upon the paper points, and before the locality labels have been attached. We do not use the sheet cork quite full length, but probably extending beyond the block some 4 or 5 inches, using the one-quarter-inch thickness of sheet cork. We are using the paper points, cut by a punch made for the purpose, but this works hardly satisfactorily, as the punch soon becomes dull and leaves the edges of the points more or less ragged. For mounting insects on these points we use ordinary glue, thinned to the proper consistency, and for holding this we use the common balsam bottle of the microscopist, with glass dropper, fitting loosely in the neck of the bottle, with ground glass cap. This last contrivance was borrowed from Dr. Hopkins, and we find that it works very nicely, indeed, as the ground-glass stopper prevents the glue from becoming too thick, while the dropper is very convenient for applying the glue to the tip of the paper points, although one needs to get a dropper with a very fine point. For locality and date labels we use neatly-printed squares, and for the printing we use the 6-point lining Gothic (No. 32) type, on a good quality of paper.

With the insects reared, or collected, and carefully mounted, they are then ready to be recorded in the accessions catalogue, if indeed this has not already been done. It very frequently happens that a species has been given an accessions catalogue number, when it is in the pupa stage, or if we have secured parasites. In this case we use the same number for all stages of development, and for the parasites, although the latter when determined are given an independent number on the accessions catalogue with a reference to the original one. It may, perhaps, be stated here, that where breeding cages are used, all records are kept on a sheet folded to go in a small, galvanized-iron case, and are thus protected from being wet or in any way injured, by a glass cover which slides into the case, over and in front of the notes. When these notes are completed the sheet is unfolded and filed away for future reference, in case we should find it advantageous to go back to the original notes. In using jelly cups, we do not place the notes inside as these often offer altogether too inviting material for some insects to use in the construction of their cocoons; so these notes are kept always upon the outside, but when they are completed they, like the others, are filed away, so that they may be referred to in case it should become necessary or desirable to do so.

Published in bulletin.	Accessions number.	Journal.	Species name.	Locality.	Date.	Name of collector or sender.	Number letter file.	Remarks.
106	3510	I, p. 20	Blissus leucopterus.	Canton, Ohio.	6, 1, 99	C. P. Baron ...	6	Abundant in meadows = a. c. 2100.
75	1525	I, p. 31	Crioceris asparagi.	Dalton, Ohio.	6, 6, 98	C. W. Mally...	....	Found all stages.
107	3106	.....	.....	Clyde, Ohio.	8, 1, 99	B. Jones	6	Attacking young wheat.

The accessions catalogue has been arranged in a way that, so far as known to me, is largely original. The left-hand page is divided into seven columns, each of which is filled out after the following manner: The first, or the one nearest to the outer margin, is used to indicate the number of the bulletin in which the information relating to the species has been published; the second space contains the accessions catalogue number; the third space indicates the number and page of the journal containing the further records relating to the species; fourth, the name of the species; fifth, the locality from which it came; sixth, date of collection or of sending, if it has been sent us by a correspondent; seventh, name of collector or sender. This occupies the entire left-hand page, while the right-hand page is divided into two spaces only. The first, or the one on the left, is quite narrow and contains the number of the letter file in which the letter accompanying the specimens, if sent by a correspondent, is filed, the remaining space being devoted to remarks, which include any short item that can be expressed in a very few words. All additional information outside of this is taken to the journal, and its position in the journal is indicated in the third space from the margin on the left-hand page, as previously indicated. When the breeding notes are finished and revised they are transferred to the journal, as every one knows that original notes, in order to be of value, must contain a great deal that it is not usually necessary to use in print. In other words, the journal is supposed to contain the essential facts obtained regarding the species, together with such details as seem of sufficient importance to include. The journal is arranged in this manner: Starting at the top of the page, first will be given the accessions catalogue number; following it on the upper line the food plant or other host if such is known, followed by the name of the species if we have it, and if parasitic the fact is also indicated. Below this is given the date of observation, and following this the note itself. It will be seen that by this means we are able not only to gather together all of the material relative to a single species, but also our own notes and records, even to the original slips that we have removed from the cages or jars. Besides this we can at once find not only the original letters from the parties sending us the material, but any replies we have previously made thereto. As I stated before this system requires considerable bookkeeping; but when we come to use our notes and correspondence, as well as to refer to the material, we find that it is but a very simple task to get it all together, and we here save much more time than we have expended in keeping our records.

It perhaps might be well to point out some of the defects in this system, as well as some features of the problem upon which we are very anxious to get additional ideas from other workers. As I stated before we sometimes find our system of numbering rather cumbersome. For instance, we collect a large amount of fallen leaves about a vineyard. These are collected in midwinter, brought into the insectary and placed

in a large cage. Soon the hibernating insects begin to appear, and then we have to give the cage a number, in order to keep this material together and prevent confusion. This accessions catalogue number stands for the original, but you will very readily see that we have to make a greater or less number of additional numbers, to cover species that we secure from this material. Of course as these go onto the accessions catalogue, and with them the name and date of appearance, and, under the head of remarks, a reference back to the original number, we can easily enough trace everything back to the mass of leaves; but it multiplies the numbers on our accessions catalogue, and when we come to dispose of the species finally the original label must be taken off and thrown aside and a new one written giving the final accessions catalogue number. This consumes considerable time, and I have been hoping to devise some way whereby we might avoid this renumbering, but so far we have failed in doing so.

I do not know how it is with other entomologists, but what we need most is an up-to-date card index of entomological literature. While I have in my private library very nearly everything of importance that has been written on the subject of insects in America, it has gotten to be a tedious affair to hunt out references, and find out definitely just what has been done during previous years by other workers. While it probably can not be well remedied at present, it certainly will do no harm to call attention to what nearly every entomologist has doubtless also experienced, namely, the fact that the card index issued by the Office of Experiment Stations is quite deficient in its treatment of entomological literature. Several times I have tried to rely upon it, and found that I have overlooked some original work of a colleague, and done him injustice unintentionally. We here hope for much help from the bibliography published by the Division of Entomology. It does not seem to me to be necessary to go over ground that has already been well covered by a careful worker; although in the rearing of insects we, of necessity, do much of this, and it is just here that we need to know exactly what has been done, as, unless we have this information, we are not able to get variations as between different localities. All of this seems to me to be quite an important feature in entomological work.

In both our collections and our breeding we aim, as much as possible, to get the exact locality from which the material came. Here again I have found considerable difficulty. Often a farmer may live anywhere from 1 to 10 miles from his post-office, and in these cases it is of course absolutely impossible to give exact localities, as his farm may lie several hundred to a thousand feet above his post-office town, or the reverse may be true. The only way that I have found to in part obviate this difficulty is to have a map of the State, showing not only the counties but the townships, mounted upon a back of thick board or plank of seasoned pine. With this mounted upon an easel near my desk, I have spread out before me the whole State. Then if I can get

a correspondent to tell me in what township he lives, and in what part of this township, I can get his location almost exactly. This map is exceedingly convenient in following out the spread or distribution of any species, as wherever it is discovered by either myself or my assistant, or wherever it is reported by our correspondents, we indicate the exact locality on our map by a small disk of colored paper, using different colored disks for different species of insects. In this way we can not only indicate in a very clear manner the spread of the species over the State year after year, but we can also indicate the extent of more or less local outbreaks, as for instance, in studying the distribution of the seventeen-year cicada in 1897, we used a small disk made from canceled 2-cent postage stamps, and wherever the cicada were observed or reported in a locality, we marked that locality by one of these disks fastened to the map by a small tack. At the end of the season we have the entire distribution, so far as we are able to obtain it, directly before us, and have but to sketch this area on a base map, by the use of oblique lines, to get a drawing ready for the engraver. Again, as illustrating the second use, that of indicating local outbreaks, of course, there is the first report to go on. This will be indicated on our map by a single colored disk. If there is much destruction, and the outbreak extends over any considerable territory, we shall very soon hear from a greater or less number of people within this area of destruction, and by indicating the location of these on our mounted map, we will, within a few days, be able to see at a glance just where the trouble is being experienced. In other words, we have the storm center, as a meteorologist would express it, indicated clearly upon our map. This takes but very little time, and I have found it a very great help, either in keeping track of the spread of insects that are known to be moving in some particular direction, or in showing the area covered by the outbreak of any pest. While it requires a little time to attach these colored disks, I think that this is more than saved when I come to prepare a drawing for the engraver, showing the area over which any species has extended or become seriously destructive. I do not know whether this scheme of mapping outbreaks and diffusions could be carried out on a larger scale on the United States map, but it seems to me that it could be used in such cases also, though perhaps in a more general way.

In the foregoing I have attempted to show the manner in which we are trying to carry on our work at the experiment station. I do not present any of these schemes as models, as we understand better than anyone else can that there are still many defects and much to be desired; but I have presented these matters with the hope and expectation that they will be of material assistance to other workers, and that they will be not only used but improved upon.

Mr. Osborn spoke of the aggravation attending the receipt of exchanges bearing only an accession number. In such cases the label should give all the known data. In preparing paper points for mounting he had obtained the best results by cutting them with a razor. He had found a card catalogue very valuable for filing data on each species.

Mr. Johnson explained a duplicate system of records used by himself at the Maryland station.

The next paper was the following:

A PROBABLE REMEDY FOR THE CRANBERRY FIREWORM.

By A. H. Kirkland, *Malden, Mass.*

The damage caused by the "fireworm," as the larva of *Rhopobota vacciniana* Pack. is commonly called, is probably the most serious hindrance to the successful cultivation of the cranberry. In Massachusetts the average annual value of the cranberry crop often exceeds $1,000,000, and at this figure there is ample testimony to show that from one-fourth to one-half the crop is destroyed by insects, chiefly by the species under consideration.

It will be recalled that this insect is a double-brooded Tortricid moth whose scale-like eggs pass the winter attached to the leaves of the cranberry, and that the larvæ draw together the young leaves and feed within the web, a habit that complicates the successful application of insecticides. The first brood seldom causes extensive injury, but the larvæ of the second brood often destroy the foliage of an entire bog, leaving acres of cranberry meadow as brown as if swept by fire. The effect of this injury, of course, is to destroy the crop and to limit the bearing of the vines the following year.

For the want of a better remedy there has developed among growers the practice of reflowing the bogs at a time when all the eggs of the first brood have hatched, and by holding the water on the bog for twenty-four hours the young larvæ are drowned. This operation, simple in itself, calls for excellent judgment on the part of the grower, and while it necessitates the outlay of considerable capital in building dikes, it affords a practical method for controlling the fireworm wherever a suitable water supply can be obtained. There are, however, hundreds of acres of otherwise valuable cranberry meadows which from their location can not be flowed, and these meadows, known paradoxically as "dry bogs," are the greatest sufferers from the fireworm. On these bogs strong tobacco water applied from sprinkling pots has been generally adopted as the best remedy for the fireworm. This treatment is expensive, the liquid costing from 2 to 4 cents per gallon, and since it must be repeated after each rain, is but partially successful.

Several years ago Prof. C. H. Fernald suggested the use of Paris green as a means for controlling this pest, but, owing to the uneven composition of this insecticide, the danger of injuring the young vines through too strong applications, and the ease with which it was washed

from the foliage, it did not prove of practical utility. With the perfection of methods of preparing arsenate of lead Professor Fernald urged the growers to make a thorough test of this insecticide, expressing confidence that from its unique qualities it would be found to give good results. At first the labor and attention to detail necessary in preparing arsenate of lead and the natural conservatism of the growers militated against extensive experiments. However, in 1898, two cranberry raisers made use of dilute mixtures of arsenate of lead and water (from three-fourths to 1⅓ pounds actual arsenate of lead to 100 gallons) with fair success. This indicated the desirability of trying greater strengths of the insecticide, an opportunity for which presented itself in the spring of the present year, when Mr. Edmund Hersey, of the Bussey Institute, requested the writer's advice in arranging a treatment for a 25-acre dry bog that had suffered severely from the fireworm in 1897 and 1898. Mr. Hersey's desire to give arsenate of lead a fair trial manifested itself in a practical way through the purchase of a liberal supply of the necessary chemicals and the engagement of the services of several men expert in spraying.

On June 5, at a time when the work of the fireworm was quite perceptible, spraying was commenced with arsenate of lead at the rate of 9 pounds (actual) to 150 gallons of water. This work continued until the 10th of the month, delayed to some extent by defects in the spraying outfit, and before the entire bog was covered the larvæ had caused a little injury in a few spots. Aside from this damage, which is mentioned merely to emphasize the rapidity with which the insects develop, there was practically no harm from the first brood, and but little was expected from the second. The latter, however, appeared on various parts of the bog, the vines having grown sufficiently to afford foliage free from poison, and a second spraying was made July 1 to 7, the insecticide being used at the rate of 13½ pounds to 150 gallons. The result of this treatment was soon apparent. All injury by the larvæ ceased, the vines set a fair crop of berries and the owners estimate that they will this year gather some 400 to 500 barrels of fruit against 100 barrels last year. With berries averaging $3 a barrel this means an increase in profits from the bog of from $1,500 to $2,000 as the result of timely spraying.

Aside from showing the probable value of arsenate of lead as a remedy for the fireworm, the experience of the present year has yielded other information of interest.

The rapidity with which damage by the insect spreads is remarkable and a few days' delay in spraying may entail the loss of the crop. Hence, it is desirable to spray an infested bog as soon as possible after the first appearance of injury. This necessitates adequate facilities in the way of apparatus and labor. Three men with an outfit in first-class order and with ample water supply should cover about 8 acres of bog in ten hours.

In the spraying operations described no glucose was used, yet the poison has adhered to the vines in a satisfactory manner.

On the merits of arsenate of lead as a remedy for the fireworm the writer wishes to take a conservative stand until the matter has been subjected to another year's testing. From the results of the present season it would seem that in this insecticide we may have a remedy for the most important insect enemy of cranberry culture.

Mr. Mally called attention to the prevalence of a cranberry insect, *Teras minuta*, in Ohio nurseries, where it attacked the tips of growing shoots.

Mr. Forbush stated that in 1898 the cranberry bog mentioned in Mr. Kirkland's paper had been sprayed with Paris green with negative results.

Mr. Marlatt pointed out that the great superiority of arsenate of lead lay in the possibility of using strong solutions without injury to foliage.

The next paper was by Mr. Webster:

AN INTERESTING OUTBREAK OF CHINCH BUG IN NORTHERN OHIO.

By F. M. Webster, *Wooster, Ohio.*

In Bulletin 17, new series, Division of Entomology, U. S. Department of Agriculture, Dr. L. O. Howard, the author, stated that in 1886 a timothy meadow located near Wakeman, Huron County, Ohio, was considerably injured by chinch bugs. Since that time the species has never been reported from that section of the State, and I have found that depredations of that particular character are only committed by the more or less brachypterous race. This has been supposed to be largely confined to the northeastern portion of the State, though there seems to be no good reason why it should not appear in northwestern Ohio also. Owing to these facts, this single occurrence in meadows, recorded by Dr. Howard, has puzzled me greatly.

Last fall there came reports of very serious destruction of meadows in Huron and Lorain counties, which lie contiguous to each other, the cause being attributed to the dry, hot weather. But an examination of the meteorological records for that section revealed the fact that there had been no weather condition sufficiently severe to affect timothy meadows in that way. A survey of the affected meadows during early spring of the present year revealed the presence of great numbers of brachypterous chinch bugs hibernating in these meadows, and the problem was solved. The species had doubtless been doing more or less injury since 1886, entirely unknown to the farmer or anyone else, thus showing the extent to which their secluded life in meadows protects them from observation. This section of the State is largely devoted to dairying, and the meadows are not as rapidly rotated with

other crops as where the cereals are grown more extensively. It looks as though we might soon discover that the price of butter and cheese had a decidedly beneficial influence on the chinch bug, even if it does not aid in the diffusion of this brachypterous, maritime race. The matter stands in about this position: The higher the price of dairy products, which is due to consumption of these products of course, the greater the area of timothy meadows; and as this lessens the area devoted to cereals there will be less rotation, thus allowing the meadows to remain intact for years, so far as the plow is concerned, thereby offering this peculiar form of the chinch bug the very conditions most favorable for its increase and diffusion.

Mr. Mally called attention to the fact that in the insects involved in this outbreak variations were found from the brachypterous almost to the long-winged form.

Association adjourned to 11 a. m., August 19.

MORNING SESSION, AUGUST 19.

Association met pursuant to adjournment, President Marlatt in the chair.

The first paper presented was the following:

SOME INSECTS OF THE YEAR IN GEORGIA.

By A. L. QUAINTANCE, *Experiment, Ga.*

There seems to be but little collected data on the injurious insects occurring in Georgia, and the following notes on certain insects sent in by correspondents, or on those observed by myself, principally at the experiment station, may be of interest to the Association.

The beanleaf-beetle, *Cerotoma trifurcata*, has been very numerous in various parts of the State. At the station adults were noticed on garden beans in considerable numbers by April 20, and from this date they seemed to increase in abundance for a period of about two weeks. In many bean patches the plants were quite stripped of leaves, and for a period of three or four weeks bean plants were practically at a standstill, and while, in most cases, plants eventually started growth again, the effect of defoliation was quite marked in the small yield of beans. Early cowpeas were also badly damaged and made but little growth while infested with the beetles.

Tests with Paris green against this insect were disappointing. The strongest spray—1 pound of Paris green to 75 gallons of water—did not seem to kill them, and but little, if any, diminution in their number could be noticed on a patch entirely sprayed with this strength of the poison. Although the mixture was neutralized with an excess (2 pounds) of lime, bean foliage was badly scalded.

Complaints about the striped cucumber beetle, *Diabrotica vittata*, began to come in by the 1st of May. Young plants of cucumber, squash, cantaloupe, and watermelon were attacked and the loss was considerable. In one case, as many as three replantings are reported to have been made. Beetles were first observed at the station April 25, and they have been quite abundant thus far, feeding on the bloom, foliage, and fruit of squash, cucumber, and cantaloupe. Larvæ have been injurious, feeding on the rind of cantaloupes where in contact with the soil, causing a roughening or warting of the skin.

Still another chrysomelid has been destructive in Georgia this year. This is the Colorado potato beetle, *Doryphora 10-lineata*. An effort was made to determine its present distribution in the State, and from the data collected, it would seem that a straight line drawn from Columbus to Savannah would separate to the north the area most seriously infested. Beetles appeared from winter quarters in the neighborhood of Griffin about April 20; adults and larvæ are now abundant on *Solanum carolinense*, feeding in company with *Doryphora juncta*. The intermating of these two species was frequently noticed this season, but eggs of hybrid origin failed to hatch and were doubtless sterile.

Early in the spring larvæ of *Diabrotica 12-punctata* occasioned considerable injury by boring into the stalk just above the roots of young field corn. This larva is much worse on low moist lands than on uplands, and it is the usual practice of farmers to plant two or three weeks later on bottoms than on uplands.

Probably our most serious grape pest at the station is the *Allorhina nitida*. They were very abundant last year, and even more so this year. Beetles appeared this season June 18. Early in July such early grapes as Presly, Early Ohio, and Janesville were attacked and badly eaten into. The beetles seemed to increase in numbers until the latter part of July, and all the season through probably destroyed 15 per cent of the grape crop. Soon after their appearance a poisoned bait of bran, sweetened with sugar, was placed upon sticks in pans where they were in the habit of flying thickest, but, so far as observed, the bait was not eaten by the beetles.

Cotton planters from several localities in Georgia, and from South Carolina and Alabama, have sent in the elaterid *Monocrepidius vespertinus*, with the statement that the beetles were eating into the young squares of cotton, and doing very serious damage. The insect has been quite abundant on the grounds of the experiment station, but, so far as I have observed, has not been injurious to cotton. I have very frequently observed them feeding on the excrement voided by the boll worm, and they have been to a great extent associated with this insect, and, in general, have had the habits of scavengers. Considerable numbers of the beetles were caged at different times, with stems of cotton-bearing squares and leaves, and in but one instance was the cotton attacked, and then very sparingly.

On April 26 specimens of adult *Ithycerus noveboracensis* were sent in by Mr. S. R. Cockrill, of Rome, Ga., with a note to the effect that the beetles were doing considerable damage by eating into the buds of his newly set out apple and peach trees. The same gentleman also sent in at the same time twigs of apple trees infested with adults of *Amphicerus bicaudatus*. Cylindrical channels had been eaten down the central part of the twig, the exit being in most cases just above a bud. This same beetle has become somewhat common in the station vineyard, and in a neighboring vineyard has become even more abundant. Specimens were collected from our vineyard March 15.

Scolytus rugulosus is very much in evidence just now in certain parts of Georgia. The numerous trees weakened by last winter's freeze have furnished them with an extended range of breeding grounds. So far as I have observed, only sickly or dying trees have been attacked.

The plum curculio began ovipositing by April 20 in early varieties of plums, and eggs were deposited later in most plums, also in apples, Crandall currants, and salmon berries. In apples as many as seven punctures were observed, and the average in plums was certainly not less than four. The scarcity of peaches and plums generally, doubtless put the beetles in unusual straits for suitable places for ovipositing.

Of Lepidoptera, the boll worm, *Heliothis armiger*, has been more than usually destructive in many parts of the State. At the station it was probably the second brood that practically destroyed early tomatoes and sweet corn. After this brood had disappeared, garden crops suffered but little from this insect, but by the middle of July complaints from cotton growers began to be heard, and in one or two cases our State entomologist, Professor Scott, found it necessary to visit the infested localities.

On May 16 Mr. C. Lancaster, of Eatonton, sent in a package of cornstalks badly infested with larvæ of *Diatræa saccharalis*. As many as seven larvæ were taken from a single stalk. Mr. Lancaster in writing speaks of the trouble as a complete epidemic all over the county. July 5 Mr. J. B. Harris, of Tugaloo, S. C., forwarded a can of pupæ and full-grown larvæ, and stated that great damage had been done to corn by this insect throughout his section of the State. A package of larvæ was also received from a correspondent in southeastern Alabama, with the statement that they had done much damage to corn in his neighborhood.

The pickle worm, *Margaronia nitidalis*, has probably occasioned the usual amount of damage throughout the State. Cantaloupes, cucumbers, and squashes were attacked, and the bloom of the squash in many cases was found to be badly infested. The succulent style was eaten and the young ovary bored into. The petals were also more or less eaten. The insect was first noticed at the experiment station July 12, when nearly full-grown larvæ were discovered infesting a patch of yellow crook-neck squash. In many localities in the State they were noticed some two or three weeks earlier than this, and several different

correspondents think that their date of appearance is usually about the middle of June.

The melon caterpillar, *Margaronia hyalinata*, seems not to have been very abundant this year. At the station I have not observed it thus far, and, of the twenty or more adults bred out from larvæ-infesting cucurbits, all proved to be *nitidalis*.

The first lepidopterous cabbage pest to attract attention was the *Plutella cruciferarum*. Larvæ of this insect were quite abundant by May 20 on cabbage and cauliflower. *Pieris rapæ* followed next, and by the middle of June had gotten to be quite destructive. Larvæ of *Pieris protodice* have not been observed this year at the station, and only one adult has been noticed.

Likewise *Plusia brassicæ* has been quite rare, but one larva having been observed. *Pionea rimosalis* has been somewhat destructive to cauliflower all during the spring and early summer. The cabbage aphis, *Aphis brassicæ*, has been but moderately abundant.

June 1, I noticed that the variety plats of onions on the station grounds were being eaten by many small woolly larvæ. Specimens of these were placed in breeding cages, and were finally bred out to the adult condition, and proved to be the *Spilosoma virginica*. Larvæ of this species were observed at various times feeding on cabbage, beets, tomatoes, and various garden vegetables.

Phlegethontius (*Protoparce*) *celeus* has been quite common on tomatoes; but one larva of *P. carolina* has thus been taken at the station, and the northern species of these tomato worms seems greatly to predominate.

Seedling onion and cabbage plants were badly damaged during the latter part of July and first of August by *Thrips tabaci* at the station. Onion tops were so chafed that they soon dried up. Their effect on young cabbage plants was to cause a curling and roughening of the leaves, and the plants were so greatly checked in their growth as to make it advisable to destroy them and replant the beds.

The melon aphis, *Aphis gossypii*, has not been very destructive until recently. Beginning with August, complaints against this insect on late cucurbits have become somewhat general.

The harlequin bug, *Murgantia histrionica*, has been quite abundant and destructive throughout the greater part of the season. They were first discovered March 27 on *Capsella bursa-pastoris*, when mating had already begun.

Adults of the squash-vine borer, *Melittia satyriniformis*, were observed May 23 among squash vines on the station grounds. Egg laying commenced in a few days. Moths from this brood began to appear by July 18, and late squash are now infested with the second brood.

The squash bug, *Anasa tristis*, has been a serious drawback to squash growing this year in many parts of the State. Adults were first noticed May 5. An unusual number seem to have passed the winter, and young from this brood were very abundant.

Mr. Webster mentioned a serious injury by the onion thrips in Ohio during the present year.

Mr. Quaintance stated that in the case of this insect he had found a proprietary insecticide "Rose leaf," containing considerable nicotine, to be the best remedy.

Mr. Pettit stated that the numbers of the onion thrips in Michigan had been greatly reduced by the multiplication of a gregarinid parasite.

Mr. Felt had found a solution of Ivory soap, 1 pound to 5 gallons water, to be an effective remedy for thrips.

Mr. Kirkland mentioned an attack by *Spilosoma virginica* on the onion fields of Revere, Mass., in 1892, which was effectually combated by the use of kerosene emulsion.

Mr. Felt then read the following:

NOTES OF THE YEAR FOR NEW YORK.

By E. P. Felt, *Albany, N. Y.*

The present season has been so busy that there has been little time to go over the summer's records in the manner I like, even before presenting notes on insects of interest. This brief paper will deal with only a few of the more important records. The larva of the willow butterfly, *Euvanessa antiopa*, has been the subject of considerable complaint from various sections of the State. An interesting attack on sugar beets was recently brought to notice. It was the work of *Systena frontalis*, though *S. hudsonias* may also have been implicated. The beetles had evidently bred beside the patch (where they were found in great numbers at the time of my visit to the locality), and then invaded the field, riddling the leaves and giving the infested patch a brownish, ragged appearance. The pest was quickly conquered by spraying with Paris green. Another insect which has attracted considerable notice, is the so-called "kissing bug," and upon which little comment is necessary, save that several cases of what I think must have been this insect's work were brought to my notice.

FOREST TENT-CATERPILLAR.

In the early summer the ravages of this caterpillar, *Clisiocampa disstria*, attracted unusual attention. In certain localities the injury was probably greater than in previous years, as is illustrated by the following vivid account by the Rev. H. U. Swinnerton, Cherry Valley, N. Y.: "Stopping trains is not a circumstance to what we have here in the way of stopping things with worms. We would stop the progress of the age if it got across the way our worms were going." He then proceeds to narrate how the train he was aboard was stalled three times between two stations about 8 miles apart. The sections suffering most were mainly in the Catskill Mountains and vicinity and on the borders of the Adirondacks, though in portions of Otsego County the

pests were fully as destructive as elsewhere. Aside from the great injury inflicted upon sugar bush here and there, these caterpillars attracted great attention from their appearing in large numbers on shade trees in many villages and cities. Had it not been for most energetic efforts on the part of both local authorities and private parties, a large proportion of the thousands of sugar maples which adorn the village of Saratoga Springs would have been defoliated. So serious was the situation that a special circular was issued and distributed through the village, in order to place in the hands of every person concise directions for controlling this pest. Shade trees in Albany, Schenectady, and other places along the Mohawk River were attacked, and in a number of instances the trees were defoliated. In certain villages 10 cents a quart was offered for all cocoons collected. As a result, 1,350 quarts were purchased by the village of Glens Falls, 450 by Mohawk, and reports of similar work in several other places also came to my knowledge.

ELM LEAF-BEETLE.

In Albany, Troy, and vicinity, this pest, *Galerucella luteola*, has been as injurious as in preceding years, except as it has been controlled by spraying with arsenites. As this pest has established itself in force at Worcester, Mass., and in a number of towns in the same county, it is very probable that it will in the course of time make its way over a much larger portion of the State of New York than has hitherto been supposed it might occupy. Up to the present I have yet to learn of its establishing itself recently in new territory in the State. In both Albany and Troy large amounts of arsenate of lead have been used with most excellent results when the applications have been timely and thorough. W. H. Swift & Co.'s prepared paste was used at the rate of 4 pounds to 100 gallons of water. In Troy over 1,500 pounds of this insecticide was applied to the trees, and the party using it is highly pleased with the results. Probably an equal amount was used in Albany. Troy furnishes an interesting example of what the elm leaf-beetle can do. Its ravages there have been much worse than in Albany, and yet the city authorities did nothing to check it, except some spraying in public parks. There was a great demand for spraying apparatus operated by skilled men, and the result has been that one individual has fitted up two power-spraying outfits of a most approved type. The first one began operations last summer and the second one the present season. Their owner has had more work than he could attend to, and it is to be presumed that he has not lost money.

ASPARAGUS BEETLES.

The twelve-spotted asparagus beetle, *Crioceris 12-punctata*, was found at Brighton, N. Y., in 1893. Last August I was somewhat surprised to receive examples of the same species from M. F. Adams, of Buf-

falo, N. Y. The present season specimens were sent in by J. U. Metz, East Amherst, N. Y., with the statement that they were present in numbers. The same insect was also received from C. H. Stuart, Newark, N. Y., but I was unable to find it on a small bunch of asparagus at Clyde, about 12 miles distant, though *C. asparagi* was abundant. The twelve-spotted asparagus beetle was reported to be present at Crosby, Yates County, by Cyrus Crosby, but as no examples were sent I can not vouch for the identification, though presumably correct. I was surprised to find this insect in several localities in the immediate vicinity of Albany, and even within the city limits. An effort was made to ascertain the distribution of this species through the voluntary observers, but though few reports were received it is probable that this species has already attained a somewhat general distribution over the territory known to be occupied by its close relative, *C. asparagi*. The latter was taken near Fort Ticonderoga by my assistant, C. S. Banks, so he informs me, and is of special interest, as it appears to be the most northern point yet recorded for this species.

SEVENTEEN-YEAR CICADA.

Considerable interest was manifested in the appearance in the western part of the State of brood 19 of *Cicada septendecem*. The following list of localities, incomplete though it be, is given as a matter of record: Cayuga County, reported very abundant by J. J. Barden at Union Springs, and as present at Auburn, by Joseph Foord. Much damage was reported from the former locality, but later this was modified, as the injury proved to be less than at first supposed. Livingston County, W. R. Houston, reported the cicada to be in numbers at Geneseo, present at Groveland, and very abundant at Avon. Monroe County, L. Hooker found them at Rochester, and M. S. Baxter sent them in from Penfield. Onondaga County, A. M. Armstrong found them in large numbers at Syracuse. Yates County, Cyrus Crosby reported them present in greater or less numbers at Dresden, Balona, Long Point, and Mays Mill.

The next paper was read by Mr. Johnson:

MISCELLANEOUS ENTOMOLOGICAL NOTES.

By W. G. Johnson, *College Park, Md.*

From the entomological standpoint, 1899 has thus far been a very peculiar year. Several species of insects have appeared in unusual numbers that are not commonly destructive. Prominent among these were the destructive pea louse, *Nectaraphora destructor*, and the stalk worm, *Crambus caliginosellus*, upon peas and young tobacco, already

reported in another place. Another one was a flea beetle, *Systena tæniata* var. *blanda*, which was first reported to me May 2 as doing serious damage to a block of Kiefer pear grafts, in which more than a hundred thousand were planted. The insects did the injury by eating out the terminals, thus stunting the growth. June 1 an insect was reported as having destroyed about 40 acres of tomatoes in Dorchester County. An examination of specimens showed that it was *S. tæniata* var. *blanda*. The injury by this species to tomatoes was widespread, and serious damage was done in the Eastern Shore counties.

Early in April I discovered a small mealy looking insect upon roots of young Kiefer pear trees in Kent County. The trees were dying in some instances, while on others the bark was turning black in spots, resembling blight, but did not extend into the bast. An examination of the roots of all trees with these blackish spots showed the presence of these insects. They evidently belong to the genus Dactylopius. I have a colony under observation, and hope to determine the species later. The roots of the young trees were laid bare and a solution of whale-oil soap, 1 to 1½ pounds to a gallon, was poured around each.

June 2, my assistant, Mr. Sanderson, observed a hemipterous insect sucking the juices out of ripening strawberries in Dorchester County. June 5, I received the same insect from a correspondent at Rapidan, Va., through the Strawberry Culturist. He wrote as follows:

> My whole crop of strawberries is being destroyed by an insect, a few of which I inclose for your inspection. Will you please tell me their name and advise me what to do to save the few berries remaining. They begin to eat the berries soon after the bloom drops and continue until they are consumed. They do not eat the plant, only the berry. There are from 50 to 100 on and around each vine. Please reply quickly.

An examination of the insect showed that it was *Myodocha serripes*, and, so far as I know, this is the first report of its injury to the strawberry. An examination of the berries on the experiment station grounds showed that the insect was present in considerable numbers. It was injuring only those berries that were lying on the ground.

May 8 a correspondent from Washington County sent me specimens of *Odontota dorsalis*, stating that it was defoliating several valuable apple trees on his place, near the woods.

The tarnished plant-bug, *Lygus pratensis*, was sent to me from Stewartstown, Pa., May 9, with the information that it was seriously damaging the unfolding buds of young Kiefer pear and plum trees in the nursery. The plum was more severely injured than the pear. May 14 the same pest was observed by me destroying the terminals of young pear trees in a Frederick County nursery. We sprayed them with a 15 per cent solution of kerosene and water successfully.

Colaspis brunnea was sent to me, through the Strawberry Culturist, from Chester, Vt., with the information that it was destroying the leaves of strawberries, beans, and buckwheat. He says, "They first begin to eat a small round hole, enlarging it until the whole leaf is

eaten. This is the first season I have seen it here." We have not observed it in Maryland this season.

In June, 1897, my attention was attracted to clusters of woolly lice on the under surface of maple leaves on the Agricultural College grounds. I identified the species as *Pemphigus acerifolii* Riley. They appeared again in 1898 and 1899. This season they were quite abundant the latter part of May, all of June, and the first half of July, after which they disappeared. They exude a large amount of honeydew, literally covering the grass or any object under the tree. The honeydew soon becomes blackish with a bluish tinge. The woolly material with which the insects are covered is easily blown off, and great quantities of it cover the ground and objects in the vicinity of infested trees. In 1898 I directed some experiments with kerosene and water, using it from 15 to 50 per cent, but found it would not penetrate the woolly mass. The most satisfactory remedy known at present is hand picking of the infested leaves. The insects cluster in large numbers on the under surface of the leaves, and are easily detected by their cottony masses. I have also had the same insect sent to me from Botetourt County, Va., where it was very abundant upon maple June 20.

The pear psylla, *Psylla pyricola*, has been unusually abundant in some large pear orchards on the Eastern Shore this season. In one instance about 4,000 dwarfed Duchesse pear trees, fifteen years old, have been so seriously damaged that they will be cut down this fall. The trees in July were almost defoliated, and what few leaves remained were yellowish and sickly. The trees have made no growth, and many of them have died this summer.

The currant worm, *Pteronus* (*Nematus*) *ribesii*, attacked currant and gooseberry early in May, and was a serious pest throughout the State. It was also reported to me from Henderson, Ky., where much injury was done to gooseberry. We used a 12 per cent solution of kerosene and water with splendid results when the larvæ were quite small. Later we found hellebore decoction, 1 ounce in 1 gallon of water, preferable, as it did not spoil the fruit.

The plum curculio, *Conotrachelus nenuphar*, has been unusually abundant this season, the principal injury having been done to the peach crop along the tide-water section of Maryland. Some injury has been done to apples in the mountain section, but not serious. Last season there was a heavy crop of peaches in the mountain section, and practically no apples. This year the reverse is true, and we would naturally expect the attack upon the apple.

The strawberry weevil, *Anthonomus signatus*, appeared again this season in quite destructive numbers. The last general outbreak of this insect was in 1896. Although the weevil was destructive this season, still a large crop of berries was gathered. May 29 the pest was reported as doing serious damage to Enhance and Lovett varieties in Alleghany County. This is the first record in our office of its occurrence in the

Allegheny Mountains. Last season, and again this year, it was reported from Washington County, in the Blue Ridge Mountains.

The grapevine flea beetle, *Haltica chalybea*, has been very abundant this season in the upper counties of the State on grapevines. Many complaints came to me the first and second weeks in June. The main injury was done to the leaves and not to the unfolding buds. Dusting the vines with air-slaked lime was very successfully used; we also used Paris green in Bordeaux solution with good results.

The Hessian fly, *Cecidomyia destructor*, although not so destructive as last season, has been conspicuously abundant in the early sown wheat of western Maryland.

The tussock moth, *Notolophus* (*Orgyia*) *leucostigma*, has been very destructive to shade trees of all kinds in Baltimore City and vicinity this summer. Every leaf was taken from some trees, and the caterpillars were so numerous they were a source of much annoyance to those residing along the infested streets.

The bag worm, *Thyridopteryx ephemeræformis*, was reported during July, as seriously injuring *Arbor vitæ* and apple trees. Hand picking and spraying with Paris green in water was found a satisfactory remedy.

The cockscomb elm-leaf gall, *Colopha ulmicola*, has been quite injurious to elms this season in the central and northern part of the State.

The catalpa sphinx, *Sphinx catalpæ*, appeared in unusual numbers this season throughout the central portion of the State. Paris green in water (5 ounces in 40 gallons) was very successfully used in all cases.

The elm-leaf beetle, *Galerucella xanthomelæna*, has done the usual amount of damage to the English elm throughout the State. At the experiment station four very large English elms have had scarcely a leaf touched. They were sprayed twice last season and twice the year before, but have not been sprayed this year. No beetles or young have been seen upon them this summer. I attribute this immunity to the spraying of last season. The work was thoroughly done, and few, if any, beetles escaped. The trees have made an unusual growth and are in full foliage.

Datana integerrima G. & R. has almost defoliated every black walnut tree in the central and northern part of the State. No satisfactory remedy has been found. In central Ohio, during August, I observed the same insect upon walnut, butternut, hickory, apple, and quince. I could not help noticing the complete defoliation of nearly every walnut tree along the Baltimore and Ohio Railroad from Bellaire to Newark, and from Newark to Columbus. At the present time (August 15) the caterpillars are ravaging hickory, apple, and quince wherever they are found near an infested walnut tree.

The melon plant-louse, *Aphis gossypii*, which was so destructive to the cantaloupe crop in 1896, has again this season appeared and ruined

many hundred acres of melons. The underspraying with a 12 to 15 per cent solution of kerosene and water has been found to be the most satisfactory remedy.

The strawberry root-louse, *Aphis forbesi*, has been very destructive to many young beds in Caroline, Dorchester, and Somerset counties. No satisfactory remedy has been discovered.

The black peach aphis, *Aphis prunicola*, so very abundant and injurious last year, has been found in only a few isolated places this season.

The striped cucumber beetle, *Diabrotica vittata*, has kept up its reputation as a destructive species during the season. It has been reported upon cantaloupe and watermelon especially.

Of the scale insects, the San Jose scale, *Aspidiotus perniciosus*, has been the most conspicuous one in our state work. We have located, by inspection and report, fifty-three new localities during the past year. In every instance the badly infested trees of no commercial value have been cut down, while others, slightly infested, have been sprayed with 20 to 30 per cent kerosene or fumigated with hydrocyanic acid gas. On peach and plum we use 20 per cent kerosene and water as a summer treatment, while on apple and pear we use 30 per cent. We so reduced the San Jose scale that we no longer fear its further spread. By eternal vigilance we expect to keep our large commercial orchards free from it.

We thought at one time that the severe weather of last winter had been very destructive to the scale in many places in the State; but we could find very few dead scales, normally protected, even upon infested trees this spring, when the temperature ranged last February from 22° to 26° below zero. I believe the San Jose scale can adapt itself to any climate where the deciduous fruits thrive.

I have just received (August 7) a letter from George E. Fisher, a general inspector for the Canadian government, in which he states that he has just examined an infested orchard where the temperature was from 2° to 22° below zero last January for two weeks, and went below 22° again in February, and that he finds the scale breeding abundantly. He further states that he believes the scale will withstand a much lower temperature than is generally believed.

The terrapin scale, *Lecanium nigrofasciatum*, has been found in a number of instances where it was doing injury to plum and peach. I have never seen a tree killed by this scale, but the fruit from infested trees is small, insipid, and usually covered with honeydew and a blackish fungous growth, making it worthless. Spraying with a 15 to 20 per cent solution of kerosene and water has proven a successful remedy.

The oyster-shell scale, *Mytilaspis pomorum*, has been very destructive to lilac, and has been reported from seven places this season. This species is double-brooded in Maryland. The over-wintered eggs hatch about the first week in May, and the young of the second brood appear the last week in July or the first week in August. This is also true of

the scurfy scale, *Chionaspis furfurus*. I noted these facts some years ago in Illinois, and mention them here again, as it is generally believed that these species are single-brooded.

Many species of insects found in stored grains and the manufactured products have been sent me from various places. The "flour weevil," *Tribolium confusum*, usually found in flour mills, has been a very common one. It is perhaps the most injurious and troublesome of the mill pests, on account of its wide and general distribution.

The Mediterranean flour moth, *Ephestia kuehniella*, has also been a conspicuous mill pest. I have bred the following hymenopterous parasites from material sent to me from New York, Pennsylvania, and California: *Habrobracon hebetor* Say, *Omorga columbiana* Ash., and *Mesostenus gracilis* Cr.[1] Some years ago I reared the first-named parasite from the flour moth from California; but this is, I believe, the first instance of the rearing of the other two from this insect.

The bolting-cloth beetle, *Tenebroides mauritanicus*, has maintained its notorious reputation as a destroyer of bolting cloth in mills. It has also been reported in stored wheat, and lately (July 20) a large grocer of Baltimore wrote me that some insect was eating through the parchment of jars containing jams and jellies imported from Liverpool, England. I examined the material July 28, and found the bolting-cloth beetle and the saw-toothed grain beetle, *Silvanus surinamensis*, responsible for the injury. There were a hundred dozen of these jars, and an examination of the original packages showed clearly that the insects were brought here with them. Cutting through the parchment covers, both beetles and their young were found feeding upon the surface of the preserves. The marmalades were more seriously infested than plums, strawberries, etc. The entire lot was fumigated with bisulphide of carbon and re-covered with new caps and parchment paper.

Before closing this paper on miscellaneous notes, I must mention the fact that the harlequin cabbage bug, *Murgantia histrionica*, which has been such a serious enemy to cabbage and allied plants for the past few years, has hardly been seen by us this season. Only one complaint of injury by it has been received at my office, and that from lower Charles County. Where they were by the thousands last year on the College farm, scarcely one can be found at the present time (August 1).

The asparagus beetle, *Crioceris asparagi*, has also been conspicuously absent this season. No reports of damage to asparagus have been received, and I have seen very few specimens during my observation tours through the State.

The cabbage plusia, *Plusia brassicæ*, ruined hundreds of acres of cabbage for us last year; but hardly a specimen has been observed this

[1] These parasites were determined for me by Mr. William H. Ashmead, of the U. S. National Museum.

season in our trucking areas, while the cabbage worm, *Pieris rapæ*, continues its depredations without any perceptible diminution.

The Colorado potato beetle, *Doryphora 10-lineata*, has not been abundant this season; but the "old-fashioned potato beetle," *Epicauta vittata*, has been present in unusual numbers. It has done much damage to potatoes, tomatoes, cabbage, beets, and other plants.

I would not consider this paper complete unless I mentioned one more insect, that has caused more correspondence, perhaps, than all the others combined. I refer to that sensational, notorious "kissing bug." If seen for the first time, the rhinoceros beetle, and the hickory horned devil (*Citheronia regalis*), the giant water bug, and the long-horned Corydalis, are all termed by the public the kissing bug. Even our ordinary cockroach has not escaped this popularity; and, very recently, the common old tumblebug (*Copris carolina*) has been accused of conduct unbecoming a bug of such ancestorial sacredness. A young schoolma'am charges him with the serious crime of inflicting a painful wound, caused by a lingering pressure, culminating in a resounding smack, and says she caught him in the act.

The following paper was then presented:

INSECTS OF THE YEAR IN OHIO.

By F. M. Webster and C. W. Mally, *Wooster, Ohio.*

Cankerworms were especially abundant in the western and northern sections of the State. About Cincinnati their attacks were more especially directed to forest trees, the elm and hackberry seeming to be the most generally attacked, though the maple also suffered, a condition that from reports appeared to occur over most of the western area, but not in the northeastern. In some cases the only portion of an orchard to suffer attack was that bordering on infested woodlands. It seemed sometimes as though the species engaged in the ravages must be different from the one ordinarily attacking orchards, but of this we were not able to make sure. A single parasite was reared from material collected near Cincinnati, but only in limited numbers.

The white grub has also been excessively abundant and destructive. As an instance of the good effects of fall plowing as a preventive measure, an intelligent farmer writes that during the first week in December, 1898, he broke a wide strip of timothy sod through the center of a field, but the weather prevented his finishing the remainder, which was broken during the spring of the present year, and all planted with corn. The result is that the fall-plowed portion, running through the center of the field, is uninjured by attacks of the grubs, it being impossible to find any large number of them there, while the

spring-plowed areas on each side are overrun with the depredators, and the crop seriously injured.

The year has also been marked by the excessive abundance of the Hessian fly and especially in early sown fields, the later sown not suffering except where located near early sown fields, and in this case the attack seems not to have fallen on the plants in the fall, as the fields then appeared uninjured, but during the spring, thus indicating a spring migration of the females from the early to the late sown fields.

The wheat midge, *Diplosis tritici*, which occurred last season in some abundance, reappeared the present year in still greater abundance. Although the injury, both last year and this, was limited wholly to later maturing wheat, there seems to be at least a possibility of a still more serious outbreak next year. Our advice to farmers to sow late this fall to avoid the Hessian fly is in some cases likely to be disregarded through fear of thus inviting the attack of the wheat midge, while, as a matter of fact, the early and late sown wheat ripen almost simultaneously, as was very clearly illustrated on the experiment station grounds the present year.

Diabrotica longicornis continues to push its way eastward across the State in destructive numbers. It is only within recent years that it has been possible to find the insect at all in the vicinity of Columbus. Now, the valley of the Scioto River, from here to the Ohio, is noted for its vast cornfields. There is one field in particular, situated near the mouth of the Scioto, that is known to have been planted to corn continuously for over a century and until now has never been affected by this pest. Within the last few weeks from points all along the Scioto River below Columbus there have come reports of the depredations of these insects. While these complaints have been that the beetles have eaten off the silk before the kernel has been fertilized, anyone who is familiar with the pest will understand that the work of the larvæ on the roots of the plants has much the same effect in foreshortening the ear. While the problem of fighting this pest is under ordinary conditions a simple one, the Scioto Valley offers some obstacles to the rotation of crops not encountered elsewhere in Ohio. At the mouth of the Scioto there is a wide flat bottom, about 2 miles wide by probably 3 or 4 miles in length, that is covered for a considerable time in spring, and occasionally at other times, by backwater from the Ohio. In spring this does not disappear until it is usually too late to devote the land to any grain crop other than corn. The difficulty here will be to find a crop with which to rotate in order to exterminate the pest.

The onion thrips, *Thrips tabaci*, has been excessively abundant in some sections, notably in the extensive onion fields in Wayne and Hardin counties. While this pest is with us every year, its abundance seems to depend upon the lack of precipitation during July and early August. Recent experiments have shown that the insect can be destroyed by the application of a whale-oil soapsuds, using 1 pound of

the soap to 12 gallons of water. It is hardly necessary to call attention to the fact that the term whale-oil soap is simply the name of the soap, as there is little of this soap made from anything except fish oil; and while this does not detract in the least from its value, and honest manufacturers do not pretend to use whale oil in making it, there seems no good reason why we should not call it fish-oil soap and be done with it.

We had hoped that these fish-oil soaps would prove so distasteful to insects that they would be thus driven from the treated plants, but so far this has not proven true, and we can now only hope to derive benefit from the killing qualities of this material.

Blister beetles, notably *Epicauta vittata*, have been excessively abundant in many localities, more complaints of their ravages having been received this year than usual. We have found Bordeaux mixture to be a good repellant, while they can be killed with fish-oil soapsuds. As there is also this year an abundance of grasshoppers, the effect on the Epicauta next year will be awaited with interest.

Melanoplus bivittata is locally abundant every year, sometimes being heard from in the same locality for several successive years, and, again, seemingly to move its habitat of excessive abundance a short distance. The chief injury is to the red clover crop, which in some places it almost totally ruins.

The grape-root worm, *Fidia viticida*, is this season unusually abundant, and the injury from last year's larvæ was very serious, despite the increase in influence that we had hoped for from the two-egg parasites described some years ago by Mr. Ashmead from material obtained about Cleveland. Fish-oil soap has been tried against the adults without effect either as fatal to them or as a repellant. At present there are some grounds for hoping that arsenate of lead may prove effective in killing off the beetles before they have oviposited. Strangely enough this insect does not appear disposed to spread out from the locality where it has long proved so disastrous, except possibly slowly to the westward. We might add that we have received information of a serious outbreak of this pest at Bloomington, Ill.

At last we have found out how to kill the rose chafer, *Macrodactylus subspinosus*. In view of the fact that the digestive apparatus of this pest seems to be proof against the poisonous or caustic effects of most drugs this seems an achievement. One-half pound of fish-oil soap dissolved in a gallon of water and sprayed upon them will kill 95 per cent of the adults, the females being especially susceptible, if the suds is sprayed directly upon them. Drenching their food plants does not seem to affect them in the least, even if 1 pound of soap is used to each gallon of water. So the question of protecting vineyards is yet unsolved. Rhubarb has been found to be a valuable bait plant, the bloom, which appears about the time of that of the grape, being especially attractive to the beetles, and while clustered on the blossoms

they can be collected or sprayed with the fish-oil soap mixture and killed. The stronger of these mixtures did not appear to affect the peach, while the weaker injures the leaves and young fruit of the grape.

In May, in Wayne County, the young buds of the blackberry were considerably injured by attacks of the larvæ of the following species of moths: *Exartema permundana* and a species near *E. fasciata*, *Oxyptilus tenuidactylus*, one of the cigar-case bearers, and a species that has not yet developed adults and is therefore as yet undetermined. Spraying the bushes, May 9, with 4 ounces Paris green in 50 gallons water proved effectual.

Colaspis brunnea has been especially abundant, the adults and larvæ feeding on the leaves of Rumex. The adults were accused of injuring corn by eating the silk before the kernels had been fertilized.

The asparagus beetle, *Crioceris asparagi*, persists in its slow but steady march westward across the State, with exasperating disregard of Dr. Merriam's carefully prepared life-zone maps. Its advance may now be indicated by its occurrence in northwestern Erie, eastern Huron, extreme northeastern Richland, northern Ashland, Wayne, Stark, and Columbiana counties. In some of these localities it has not been before observed, and careful search has failed to reveal its presence at all in this State to the westward of the line indicated. It made its first appearance at Wooster, on the experiment station farm, this spring, and is found only singly or in limited numbers along the border indicated. In one instance the larvæ were being destroyed by *Podisus spinosus*.

The harlequin cabbage bug, *Murgantia histrionica*, has certainly sustained a severe repulse by the low temperature of last winter. While the insect was observed breeding in Clermont County, southern Ohio, last May, its almost entire absence has been reported in localities where last year it was disastrously abundant. From this it would appear that only the most hardy or best protected individuals have survived in Ohio, and we may now look for it to again attempt to push its way northward until it is again driven back by adverse meteorological conditions.

The grape sawfly, *Selandria vitis*, was reported, with specimens, from Holmes County August 11. All stages except the pupæ were sent to the station, the larvæ varying in size from very young to nearly or quite full grown. This is the first time that it has been reported to us from Ohio, though it seems to occur in profusion in this one locality.

The grape-berry moth, *Eudemis botrana*. This insect seems to winter over in the larval stage in the seed clusters of sumach. Some of the seed clusters were collected about Wooster, September 20, 1898, and from them great numbers of moths issued in the insectary during the following winter. Clusters collected in the same locality as those just mentioned, January 23, 1899, gave us not a single adult, though there were numerous dead larvæ in them when collected. There are no vineyards of any consequence about Wooster. Seed clusters of sumach

collected at Gypsum, Ottawa County, January 17, 1899, gave us no adults at all of this species, but swarms of *Canarsia hammondii*, though there are extensive vineyards in the immediate vicinity of where these seed clusters were collected, and *E. botrana* was destructively abundant here in 1897 and quite abundant in 1898. A large quantity of fallen leaves collected in and about these vineyards January 17, 1899, did not give us a single grape-berry moth in the insectary, nor did this lot of leaves, like those collected in precisely the same locality May 6, 1898, give us a single adult of the grapevine gallmaker, *Ampeloglypter sesostris*, or the clover-hay moth, *Pyralis costalis*.

Hadena devastatrix. The larvæ of this species were very abundant in winter-broken bottom sodland near Troy, Ohio. This ground was planted to seedling peaches in spring and by June 5, 1899, fully 35 per cent of these had been cut off about 2 or 3 inches above the roots, and thus destroyed. A single larvæ was taken in the act of attacking a young plant June 5. This pupated on the 12th and the adult emerged on 26th.

The injury that has been observed by Professors Rolfs and Johnson and discussed by these gentlemen in Entomological News, seems to be done in Ohio by the tarnished plant bug, *Lygus pratensis*. No evidence of the presence of any such insect as mentioned by them has been found, while the extent of injury has been observed to coincide with the abundance of *L. pratensis* in the peach nurseries. Our nurserymen state that they frequently find the pest at its work and are sure that they are not mistaken.

Chramesus icoriæ. This was reared from twigs of walnut tree, collected at East Cleveland April 7, 1897.

Gymnetron teter. Adults were jarred from plum trees May 28, 1898, at Wooster, and observed at Mantua swarming among leaves of mullein, June 8, 1897.

Two larvæ, found at Mount Union July 22, 1898, about a decaying beech stump, were brought to the insectary, together with a mass of the decaying wood in which they were found apparently feeding, all being placed in a jelly cup. These larvæ formed cocoons of the material in which they were collected August 1898, the cocoons resembling those constructed by the larvæ of *Lucanus dama*. May 29, 1899, one of the cocoons was opened and found to be filled with a white fungus resembling *Sporotrichum*. This was referred to Dr. Thaxter, who replied under date of June 11 as follows: "The fungus was not in very good condition when received, so that I have waited for it to develop before answering. It proves to be the *Sporotrichum globuliferum* that seems to attack insects so universally."

Agromyza æneiventris. Larvæ found burrowing in pith of the common garden sunflower, at Wooster, October 19, 1898, on being transferred within this pith to the insectary gave us adult flies during January and February, 1899. In Indiana, in 1886, Mr. Webster reared this species

from stems of white clover, in this case the larvæ and pupæ being found in the plants August 5 to 10, and adults appearing on the 12th. It thus appears that the species is at least two-brooded.

Laverna gleditschiella. Since this species was reared and described by Mr. Chambers, at Covington, Ky., many years ago, it has not since been taken by other entomologists elsewhere. From a lot of the thorns of the honey locust, collected at Plainville, Ohio, May 14, 1899, and sent to Wooster in a cigar box, there emerged in transit several adults of this beautiful species. Also, in connection with them, the parasite and the minute ant mentioned by Mr. Chambers were both observed, and the movements of the former were exactly as represented by him, thus showing the faithfulness of this gentleman's observations and records.

Of the beneficial insects that have been observed in particular abundance the present year, we may note *Podabrus tomentosus*, *Telephorus bilineatus*, and *Megilla maculata*. With the little *Smilia misella*, from which so much help has been expected in holding the San José scale in check, the contrary is true. There are not more than half as many of these insects as there were a year ago, thus counteracting the effect of the winter on the scale itself.

The president then called Mr. Webster to the chair and presented the following:

TEMPERATURE CONTROL OF SCALE INSECTS.

By C. L. Marlatt, *Washington, D. C.*

The fact that climatic conditions play the most important rôle as a controlling factor in the multiplication of scale insects particularly has been very strongly impressed on the writer during the last few years. In other words, he believes favorable or unfavorable climatic conditions to be of far greater importance in determining the abundance or scarcity of scale insects than such other natural checks as parasitic and other insect and animal enemies, or even fungous or bacterial diseases.

The importance of temperature control was especially impressed on the writer during an examination of European conditions a year or so since, and the conviction was forced upon him that for most of Europe climate has more to do with the immunity from scale insects than any other agency. The unfavorable features of the climate of middle Europe are its shorter and cooler summers and greater moisture and consequently less amount of sunshine. Where the conditions named do not apply, the immunity is to be explained by the great dryness and heat of the summer, which apparently results in the burning up and drying out of most scale insects, so that damage from this source is insignificant and rare.

Mr. Theodore Pergande, who has also visited Europe recently, tells him that he finds, so far as Germany and middle Europe are concerned, the same conditions, having found both scale insects and plant lice very scarce as compared with eastern America.

In America our longer summers, or rather longer Indian summers, with our much greater preponderance of sunshine, accompanied, however, with an adequate amount of moisture, seem to be the disposing cause which leads to the serious affliction of the many scale insects experienced with us. We have, however, climates which parallel those of Europe. For instance, in California, away from the coast, the hot dry summers of Italy and Spain are duplicated, and with similar results on scale pests. The writer drew attention to this condition of affairs in a paper published in the Yearbook of the Department of Agriculture for 1896, entitled "Insect control in California." The paragraph in question is as follows:

Other influences which have an important bearing on the relations of insects to fruits in California are the climatic conditions, particularly the summer heat and the long summer drought. Heat is a most important factor, and it has been repeatedly demonstrated that where the temperature remains, as it often does, at 106° F., or above, for two or three days, at least two-thirds of the black scale are killed. As an illustration of this, it may be stated that during the summer of 1896, when the drought was unusually severe and the temperature correspondingly excessive, it was the experience at Riverside that at least 90 per cent of the black scale was destroyed by heat, including even eggs beneath the parent scales. The benefit from this source obtains in greater or less degree in the case of all the important scale insects of both citrus and deciduous trees, and is a means of protection which is rarely if ever experienced in cooler or moister climates; in fact, it does not hold in northern California, where the rainfall is greater and the summer temperature less severe. The destruction of scale insects from this cause may be facilitated by the system of pruning which opens up the tree by the removal of interior growth, and such pruning is practiced and recommended by many growers in southern California.

When considered, however, in connection with the imported ladybird enemies of scale insects, which will be later discussed, the dry heat and pruning are both inimical. These introduced parasites need a certain amount of moisture for successful multiplication; hence their usefulness is most marked in the moister coast region, and advocates of reliance on parasites discourage pruning, since a dense interior of citrus and other trees furnishes the needed shade and moisture, and also protects from bird and other enemies. The need of such protection is illustrated about San Francisco and northward, where the imported ladybirds are less successful on account of lack of shelter afforded by deciduous trees, particularly in winter.

An interesting confirmation of the views there expressed comes in a recent letter from one of the horticultural commissioners of Riverside County, Mr. Felix G. Havens. Writing under date of June 8, 1899, he says:

If Mr. Marlatt is in the office, please tell him that the black scale which was so plentiful on the orange trees at the time he was here in November, 1896, and which we found at that time to be about 95 per cent dead, has since entirely disappeared. I believe the Riverside orange district, comprising about 14,000 acres, is the largest citrus district in the world, and the freest from insect pests as well.

Different species of scale insects undoubtedly behave in different manners under adverse climatic conditions, but it is undoubtedly a general and important rule that with them, as with other insects, a cold and wet climate is especially unfavorable, also an excessively hot and dry climate; and the favorite climate for Coccidæ is undoubtedly the intermediate one furnishing plenty of sunshine and warmth with a medium amount of moisture.

The above remarks apply altogether to the effect of summer temperature and climate; the winter climate as a rule is less important, because the insects concerned have become inured to the normal cold of winter and hibernate in a condition of growth which best protects them from severe freezing cold in temperate climates.

The excessive cold, however, experienced during the winter of 1898–99, aroused the writer's curiosity as to the ultimate effect upon scale insects, and led to an examination of all the local species occurring on out-of-door plants available.[1]

. Referring to the conditions about Washington, it will be remembered that, although well south, the District of Columbia suffered perhaps as severe cold as any part of the United States, except perhaps the extreme northwest. Unheard-of low temperatures were reached for this region and latitude, and many plants were greatly injured or killed to the ground which normally winter without any harm from the cold. Even peach trees were often completely killed. As would have been expected, a great mortality was found to have ensued among scale insects, ranging as a rule above 95 per cent, and in some cases to 100 per cent.

Among the scale insects examined were *Diaspis pentagona* and a variety of this species, *Diaspis rosæ*, *Aspidiotus perniciosus*, *Aspidiotus tenebricosus*, *Aspidiotus diffinis*, *Asterodiaspis quercicola*, *Lecanium nigrofasciatum*, *Chionaspis pinifoliæ*, and several species which winter in the egg stage. In the case of scales of the latter class, in some instances many if not all of the eggs seem to have been killed by the low temperature. Especially was this true of a species of Prosopophora occurring on a variety of Æsculus growing in the Department grounds.

The local results described were duplicated, as a rule, in the cases of scale-infested twigs sent in for examination or identification from other localities.

The only divergent results secured were in the case of *Aspidiotus ostreæformis*, from Geneva, N. Y. These scales seem to have been uninjured as a result of the low temperature, but it is possible that this is to be explained by the infested plants having been unusually protected in some way.

[1] Prof. F. M. Webster in the June Canadian Entomologist (p. 130) has already drawn attention to the fact of the destruction of *Diaspis amygdali* in Ohio by the extremely low temperature reached last winter.

It will be seen that the cold of the winter in question was as efficient as an ordinary treatment with the best of our insecticides.

In the latitude of Washington and southward the result of unusual cold is apt to be much more noticed than in more northerly latitudes, where the temperature conditions of winter are more uniform. From Washington southward the multiplication of many species of scale insects is checked only for a very short period by cold weather, or, at least, the breeding continues until December, or even into January, and this renders these insects in such latitudes especially liable to destruction by any sudden and unusual falling of temperature.

There is probably another reason, also, which acts in the same way, namely, it is to be inferred, and the experience of last winter rather corroborates this belief, that the scale covering secreted by the insects in warmer latitudes is less dense and furnishes less protection against sudden changes in temperature than in the case of the same species farther north; and this, in connection with the absence or great reduction of the resting or hibernating period, will undoubtedly account for the complete killing out of the scale insects here and there throughout the South, as has rather frequently been brought to our notice.

Such conditions may often be very local and perhaps sufficiently so to explain the almost complete extermination of scale insects in a particular orchard in such weather. It is not an unfamiliar experience on the Eastern Shore of Maryland, for example, that the cold-air waves are so restricted in area that a single orchard or series of orchards in a single line of territory of not exceeding a mile or two in width will have the fruit buds killed, while neighboring orchards on either side of this strip escape uninjured.

The fact is frequently noted that scale insects sent to this office for determination are practically all of them dying under natural conditions, and while the inference is a very natural one that they have succumbed to some disease, this does not seem to be the necessary and invariable explanation, and there is no doubt that very often some adverse climatic or temperature conditions have been the cause. Almost any dead scale insect attracts saprophytic fungi, and examination of such material nearly always shows fungus mycelium. Undoubtedly most of the saprophytic fungi gain access to the insects after the limbs bearing them have been removed from the plant and the insects are in a dead or dying condition.

AN ACCOUNT OF ASPIDIOTUS OSTREÆFORMIS.

By C. L. Marlatt, *Washington, D. C.*

In an article in *Science* for July 7, 1899 (pp. 18–20), the writer gave a preliminary account of a European scale insect enemy of deciduous trees, which had apparently recently been introduced into the United States and was rather rapidly spreading and becoming established.

For a general account of the distribution of this scale in this country and also in Europe, the reader is referred to the article cited. The importance of this scale to our horticulturists has increased rather than diminished by the record of the two or three months which have elapsed since public attention was first drawn to it by the article in question.

It may be well therefore to repeat the ideas expressed in the opening paragraph of the article in *Science*, namely, that it is certainly in order, in view of the activity and zealousness displayed by several European countries in excluding American fruits and plants upon the pretext of contamination by the San José scale, to draw attention to and emphasize the fact that a dangerous, and perhap a very dangerous, European scale insect, *Aspidiotus ostreæformis* Curtis, has recently become well established in this country from imported European stock. *Aspidiotus ostreæformis* is a well-known pest on various fruit trees in Europe, has a very wide distribution, is very similar to the San Jose scale in appearance and habits, and is liable to be almost if not equally as mischievous, judging from the examples of badly infested material which have come to the office of the Division of Entomology at Washington for determination, and from reports already received of actual damage in orchards. In other words, we have already recently received, and the importation is liable all the time to be repeated, a scale insect probably as undesirable as the San Jose scale, and which if equally widely distributed and equally actively exploited would doubtless assume similar importance; with this advantage to us, however, that coming from Europe to America there could be legitimately no restrictions upon our commerce with Europe as a consequence.

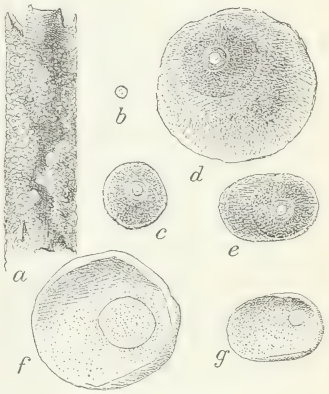


Fig. 1.—*Aspidiotus ostreæformis: a*, infested twig, natural size; *b*, life size female scale; *c*, half-grown female scale; *d*, full-grown female scale; *e*, full-grown male scale; *f*, female scale from below; *g*, male scale from below; *c–f*, greatly enlarged (original).

Since the article referred to above appeared in print opportunity has offered to make some further studies of the habits of the species, given below, and to these are added a description of the male and female scales and the adult female insect. In the meantime also several additional localities for this scale have been brought to notice by various correspondents of the Division of Entomology, U. S. Department of Agriculture. A brief summary of the new records follows:

From Canada it has been received from Mr. John Dearness on apple at London, Ontario, July 20, and on plum at Kingsville, Ontario, August 9, and from Mr. W. Lochhead on plum also from Kingsville, Ontario,

and on bark from the same locality, also on bark and twig from St. Catherines, presumably from different localities, all sent under date of September 22.

From Michigan it has been received from several localities. Under date of July 24, Mr. R. H. Pettit, of Agricultural College, Mich., sent examples from South Frankfort, collected in July, 1899; from Douglas, collected April, 1899; from Mears, collected March, 1897, and from Ganges, collected March, 1897. Additional specimens also have been received from South Haven, Mich., from Prof. L. R. Taft and Mr. Pettit, the material having been communicated by Mr. S. H. Fulton, South Haven. As described by Professor Taft, the infested orchard is about 4 miles south of South Haven, and comprises some twenty trees only. One of these died in midsummer, apparently from the effects of the scale; and the owner removed three or four others which were badly affected, spraying the remainder with kerosene emulsion. Mr. Pettit assures us that this scale insect will kill trees, reporting several large soft maple trees (*Acer dasycarpum*) to be in bad shape, two of them being killed outright as a result of its attacks. As reported to Mr. Pettit by the owner of the orchard, Mr. Fulton, at South Haven, the infested stock came from Lockport, N. Y., the trees being purchased some nine or ten years ago, which would seem to connect the Michigan infestation directly with the New York stock described in the article in Science.

A new and unexpected locality for the scale is indicated by specimens received from Boise, Idaho, communicated August 19, 1899, by Mr. A. McPherson. The trees attacked are plum trees, and the infestation is quite serious. The history of the infested stock was not given.

The infestation in New York, as noted in Science, seems to have been the original one in this country, and some inquiry was made as to the history of the scale in that State. Mr. George G. Atwood, who has had perhaps as much experience with this scale in New York as anyone else, writes, under date of July 1, 1899, in response to an inquiry from this office, that *Aspidiotus ostreæformis* was first discovered by him in August, 1898, while inspecting nursery trees about two or three years of age. At first he mistook the scale for *ancylus*. Last winter, however, while inspecting some of the large orchards of Ontario and Seneca counties, this scale was found on European plum trees perhaps twenty years of age and coming from a nursery established in New York fifty years ago. Infested varieties are Reine Cloude de Bavary, Bradshaw, and Lombard, and are generally grown by nurserymen, but infested stock was present in only three out of one hundred and twenty nurseries inspected by Mr. Atwood. It was found also in but two orchards. This relates to the material identified by the Division of Entomology.

He says that, while this scale was discovered by him in New York within a little over a year, he believes that it has been present a good many years, the varieties which it infests coming from old nurseries,

and he thinks the scale has been present in New York for thirty years or more.

He states that *ostreæformis*, like *ancylus*, does not multiply or spread rapidly. The hatching period is later than that of the San Jose scale, and the species does not have as many broods as the latter, and is also apparently more parasitized.

Aspidiotus ostreæformis winters in about the same stage of growth as the San Jose scale, namely, in the half-grown second stage. Maturity is reached about the end of June, judging from material received from Geneva, N. Y. In one lot fully one-half of the young had appeared by the 25th of June; and in another, hatching had just begun on the 30th of June. The species is ovoviviparous—that is, the young are fully developed within the mother female and escape from the inclosing amnion just before or at the moment of birth.

To determine the number of broods, a lot of young, secured from material just mentioned, were colonized on a young pear tree in the insectary of the Department about July 1. This experiment came to naught, on account of the fact that all of the female scales and most of the male scales were parasitized before reaching maturity. The insect may be single brooded, at least in its northern range, but the number of broods is still in doubt and is a matter which demands careful investigation. Irrespective of the number of broods, the insect is capable of very great multiplication, and even of causing the death of trees, as has been already stated.

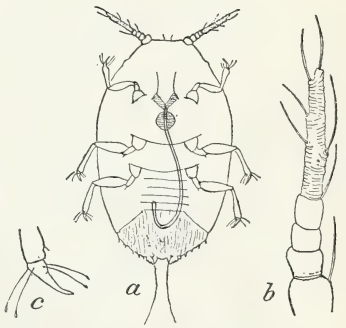


Fig. 2.—*Aspidiotus ostreæformis: a*, young larva, from beneath, much enlarged; *b*, antenna, and *c*, claw, of same, more enlarged (original).

DESCRIPTION OF THE FEMALE AND MALE SCALES.

Female scale.—The fully formed scale of the adult female on smooth, clean bark, and where not too crowded, often reaches a diameter of 3 mm., and is not much elevated. It is circular, the exuviæ central, and easily exposed by rubbing, or often is self-ruptured, showing the small orange-colored larval exuvia, as in *A. ancylus*, *forbesi*, etc. The larval scale is yellowish-white, bleaching to a light grayish-white in older individuals, if it be not broken or rubbed off as noted. The scale secreted by the second stage is very dark gray, almost black, and has a diameter of about 1 mm. The supplemental scale secreted by the adult female often enlarges the completed scale to treble the diameter of the scale of the second stage, and when clear and fresh is light yellowish-brown in color. The inverted scale exhibits the large orange-yellow exuvia of the second stage, appearing at the central part of the scale and nearly equaling

in size the dark-colored exterior central portion of the scale. The ventral scale is insignificant.

Male scale.—The scale of the male is elongate oval, having a length of about 1 mm. The exuvia is near one end, and as a rule exposed.

It is unusual to find the scale of this species entirely free from extraneous matter, and it adheres so closely to the bark that invariably any loose vegetable fibers or adhering foreign matter is lifted and carried over the surface of the scale so that the latter is often obscured by sooty fungus, dirt, or the epithelial cells of the bark. On young twigs the hyaline epithelial layer of the bark is raised and adheres to the scale,

Fig. 3.—*Aspidiotus ostreæformis: a*, adult male insect; *b*, adult female; both much enlarged (original).

giving it a uniform grayish tint throughout, and making it almost impossible to determine, without dissection, the limits of the scale. On wood infested for two or three years, the scale often exhibits a raised or puffed appearance, due partly to the constant elevation of the old scales by the new ones forming beneath them and the disintegrating action of moisture, and also to the action of various saprophytic and perhaps parasitic fungi.

The larval scale is yellowish-white, and occurs in clusters under the old female, and also on all free bark adjoining.

DESCRIPTION OF THE ADULT FEMALE INSECT.

The adult female is a rather larger insect than any one of its near allies, except *A. juglans-regiæ*. It often attains a diameter of 1½ mm., and is nearly circular, the anal plate in spent females being, however, slightly retracted, giving the insect a slightly kidney-shaped appearance. The female is quite flat, even when in the gravid condition, a form necessitated by the nature of the covering scale. (Fig. 4.)

The terminal segment or anal plate has the following peculiarities: The lateral groups of the paragenital glands are arranged in rather circular

or compact masses instead of in the more elongate or serial order, seen in *ancylus* and *forbesi*. The anterior group usually has much fewer pores than the lateral groups. Six is an average number for the anterior group, and ten or twelve each for the four lateral groups. The median lobes are large, distinctly notched exteriorly. The second pair of lobes are very minute, narrow, and notched, as in the case of the median pair, but having a very characteristic form which is quite uniform in different specimens, and furnishes one of the best means of recognizing the species. The chitinous processes between the lobes are very small, subequal. The plates are minute and inconspicuous. The dorsal pores are quite characteristic; there are usually two between the first pair of processes, and a row of five or six extending from the second pair of

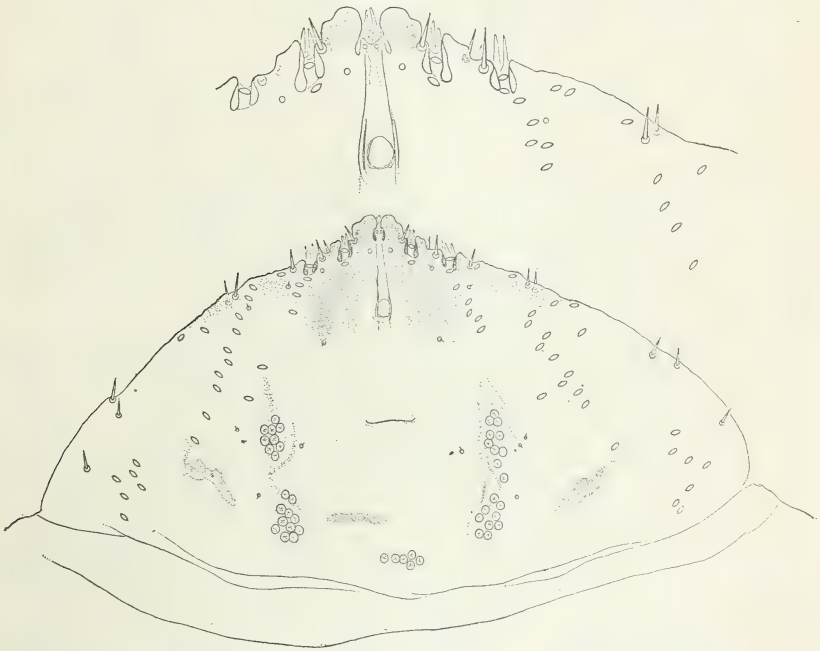


Fig. 4.—*Aspidiotus ostreæformis:* Much enlarged view of last segment of adult female insect, with tip of same more enlarged above (original).

processes, and after a considerable interval continued near the lower group of paragenital glands in one or two additional pores. A lateral row of about ten or eleven pores extends from near the base of the first pair of spines to the lateral chitinous thickenings. Differing from most of its near allies, it has a group of six or seven pores near the basal angles of this segment. Other characteristic features of the anal plate are shown in the accompanying figure.

The anus is very minute and quite distant from the median lobes. The spines and minute ventral hairs do not differ from those of allied

species. The features most characteristic of the species and enabling its ready recognition are the peculiar character of the second pair of lobes, the more massed or irregularly circular arrangement of the paragenital glands, and the number and arrangement of the dorsal pores.

The following members were appointed a committee for nomination of officers for the ensuing year: Messrs. Osborn, Webster, and Scott.

Adjourned to 2 p. m.

AFTERNOON SESSION, AUGUST 19.

Met according to adjournment. President Marlatt in the chair.

The first paper of the afternoon was presented by Mr. Scott.

FATAL TEMPERATURE FOR SOME COCCIDS IN GEORGIA.

By W. M. Scott, *Atlanta, Ga.*

On the 12th and 13th of February, 1899, Georgia experienced the coldest spell of weather that has visited that State for many years. In Atlanta the temperature fell to 3° F. on the 12th and — 8° on the 13th. In south Georgia, reaching to the Florida line, the minimum temperature for the 13th ranged from 0° to —6° F.

This severe freeze had a destructive effect on certain scale insects, while others seem not to have been affected at all. On February 28, fifteen days after the freeze, I commenced to investigate the condition of the San Jose scale (*Aspidiotus perniciosus*) in southwest Georgia, and continued the work until infested orchards in nearly every portion of the State where scales exist were examined. Wherever cases of San Jose scale have been found in north Georgia, such severe measures have been adopted to eradicate them that opportunity was not afforded to note the effects of the freeze on the scale in this north Georgia section; therefore these notes refer only to south Georgia.

In November, 1898, the San Jose scale was discovered at Albany, Ga., thoroughly infesting about one dozen peach and plum trees in a back dooryard. These trees were condemned and ordered either to be treated or dug up. The owner of the premises died soon thereafter, and the scales were left unmolested until February 28, when I inspected the premises again and found the scales apparently all dead. Upon a thorough inspection of the infested trees, not a living scale could be found. The minimum temperature for Albany February 13 was — 4° F. The San Jose scale has been at Cuthbert, Ga., for several years, and large commercial orchards are infested. Some of these orchards had been treated before the February freeze and others had not. On March 2 I made an inspection of these orchards and only found a very few live scales. Orchards that had been sprayed with 25 per cent

kerosene in mechanical mixture with water shortly before the freeze showed no live scales at all. On untreated trees, where the scales were heavily crusted over the trunk and limbs, an occasional live scale could be found. At Danville, Ga., on March 14 I examined an orchard of 20,000 peach trees previously badly infested with the San Jose scale, so badly, in fact, that several thousand trees had been killed outright. This orchard had never been treated. A thorough examination of infested trees showed a very small percentage of scales living. An orchard of 10,000 peach trees in the same locality sprayed with 25 per cent kerosene mixture in January and February showed a much smaller per centage of living scales; indeed, it was only with very careful search that a few living specimens were found.

The Tifton section was one of the first of the State to become infested. Radiating from Tifton as a center, the scale has thoroughly spread over three adjoining counties—Berrien, Worth, and Irwin—involving orchards of 5,000 to 50,000 peach and plum trees. It has been impossible to have all of these orchards treated, and ample opportunity was afforded to note the effects of the freeze on the scale in this section. No official record of the temperature was made at Tifton, but local thermometers ranged from 0° to —2° F. during the freeze. This section was inspected March 29–31, and a much larger per cent of the scales found living than in any of the other sections noted. The effects of the freeze, however, were very apparent. Infested orchards in other sections were examined, showing about the same general condition of the scale as given in the cases above cited. Many of these orchards were reexamined from time to time during the summer up to as late as August 1. The scale has made very little progress this season. Reproduction has been slow. Where trees were creeping with young scale insects last year, only a few can be observed this season. Orchards that looked as though they were beyond recovery last season have taken on new growth and are vigorous again. Making a rough estimate, I would say that about 90 per cent of the San Jose scale in infested orchards in Georgia were killed by the February freeze. Most of our growers, however, understand that the small percentage which escaped the freeze is sufficient to thoroughly reinfest their orchards, if left unmolested. They, therefore, have not claimed a victory and given up the fight so vigorously begun, but have taken new courage and are striking while the scale is at its weakest.

Under conditions existing in the North, the San Jose scale lives through the winter at a much lower temperature than was reached in Georgia last February. This freezing out of the scale in Georgia, while the same insect withstands the greater cold of more northern latitudes, may be explained by the fact that the scales had been awakened from their winter hibernation by a few warm days that occurred just previous to the freeze. Even a few young scales were issuing from specimens received from Cairo, Ga., during the warm days. Caught in this semi-

active condition, they were not able to withstand the sudden fall in the temperature. Moreover, insects, as is also the case with plants, are not as well protected and do not become as dormant in southern latitudes as they do at the North, and are, therefore, not able to withstand such unusual cold as was brought on by the February blizzard.

Diaspis amygdali was almost totally destroyed by the freeze. At Irby, Ga., on March 13, I examined an orchard of about 12,000 peach trees more or less infested with this coccid, and was unable to find a single live scale. Two seedling trees, white with scales, were taken from a fence corner by this orchard and transplanted in a garden in Atlanta to determine whether or not any female scales were left to breed. One of the trees died. Up to date no living scales have been found on the other one.

The case at Bainbridge, Ga., was examined June 30. A dozen trees are still standing on Mrs. E. Johnson's place, and these were white with scales last fall. At the above date the trees were nearly clean. Some dead scales were found on all of the trees, but no live ones could be found except on two trees. At the base of two trees standing on the east side of an outhouse a few live scales were found.

On October 6, 1898, I inspected an orchard of 25,000 peach trees at Irby, Ga., and found the whole orchard thoroughly infested with *D. amygdali*. About 1,000 trees had the appearance of being covered with snow. This orchard should have been treated during the winter, but was not, on account of so much rainy weather before the freeze, and it was not thought necessary after the freeze. On June 31, 1899, this orchard was thoroughly inspected, and living scales could only be found occasionally at the base of the trees, where they had been protected by dry grass, and perhaps the snow that accompanied the freeze. Also, a few scales could be found occasionally in the forks of limbs and under pieces of bark where they were well protected.

This coccid is also known to withstand the greater cold of more northern latitudes. In the Canadian Entomologist, Volume XXXI, page 130, Prof. F. M. Webster states that *D. amygdali* infesting a tree from Japan, planted out on the grounds of the Ohio Experiment station at Wooster, Ohio, withstood the temperature of —9° F. in the winter of 1897–98. He states further, however, that a temperature of —21° F., reached in the winter of 1898–99, apparently destroyed all of the scales on the trees under observation, as not a living specimen could be found.

Aspidiotus nerii was also under observation at Albany and Thomasville, Ga., infesting chinaberry trees on the streets of these towns, but the infested trees died from the effects of the freeze, and it could not be determined what direct effect the cold had upon the scales. Last summer the leaves of a number of sweet-gum trees on the streets of Atlanta were badly infested with *A. nerii*, and up to date this season not a living scale can be found on these trees. While this may be due

to some other cause, it can with reason be attributed to the low temperature.

Aspidiotus forbesi seems to have been affected very little if at all. This scale is well distributed all over the State, and large orchards are infested. It was quite bad last year, killing a number of trees. Plenty of live scales could be found soon after the freeze, but they have not multiplied so rapidly and are not so abundant this season as last. This decrease in the *forbesi* is due, I think, to the work of the fungus *Sphærostilbe coccophila* and the ladybird beetle *Chilocorus bivulnerus*, both of which are very abundant on this scale, rather than the effects of the freeze.

Mr. Webster expressed the opinion that the San Jose scale breeds continuously when climatic conditions permit. He mentioned finding young scales in January. Doubtless the cold of winter kills the young, but the mature scales survive and continue breeding. Oddly enough, he had experienced difficulty in establishing the San Jose scale in the greenhouse at his insectary, his efforts for two years being unsuccessful.

The following paper was then presented:

THE DESTRUCTION OF HAIRY CATERPILLARS BY BIRDS.

By E. H. Forbush, *Malden, Mass.*

Among his first recollections of bird life the writer remembers, when a boy, watching a red-eyed vireo in a swampy thicket. He was attracted by its intermittent singing, and on nearer approach saw that during each intermission of the song the bird was killing and eating a caterpillar or other insect. This observation opened a new field for study, through which in later years many interesting facts in regard to the food of birds have come to light.

It was learned that birds, by reason of their great powers of flight and vision, were better fitted to search for food over a wide area than any other creatures; that they could readily gather from all quarters and thus concentrate their forces upon any spot where food was plentiful, and that they were thus designed as the principal agency among the higher animals for regulating the increase of insects and controlling insect outbreaks. It was learned that a tremendous amount of food was required for the sustenance of birds, and also that the young of most of the land species require a vast quantity of animal food to assure their rapid and healthy growth; furthermore, that most birds supply the wants of their young with insects.

It is now generally admitted by all who have knowledge of the subject that birds constitute one of the principal checks on the undue multiplication of insect life; but it is maintained that many insects are not attacked by birds and that many others are nearly exempt from such attacks by reason of protective coloring or their outer clothing of

hairs or spines, which are supposed to be so disagreeable to the taste of birds as to grant such insects immunity from attack. In such research as the writer has been able to make in entomological literature the statement frequently has been met with that birds will not eat hairy caterpillars. This astonishing error has been repeated time after time until it has come to be regarded as a sort of axiom among both entomologists and ornithologists.

Years ago the writer learned by observation that cuckoos, orioles, vireos, and titmice were destroying a great many hairy caterpillars. When our work on the gipsy moth was begun in Massachusetts in 1891, the men employed were instructed to watch carefully all enemies of the gipsy moth and to note to what extent these enemies affected the moths' increase. Among these men there were at that time eleven who were familiar with the common native birds. Reports that certain species of birds were eating the gipsy caterpillars began to come in freely. These reports and their confirmation caused the continuance of careful observations during the past nine years. As a result of these observations, supplemented by stomach examinations, we now have much accurate information as to what extent our common land birds eat certain hairy caterpillars. The observations recorded have been made mainly with reference to four species of caterpillars which can be readily identified by the observer, all of which are now common in the district infested by the gipsy moth in Massachusetts, viz, the gipsy-moth caterpillar (*Porthetria dispar*), the brown-tail caterpillar (*Euproctis chrysorrhœa*), the tent caterpillar (*Clisiocampa americana*), and forest tent caterpillar (*Clisiocampa disstria*). Every care has been used to secure the most accurate results from these observations. The caterpillars have been carefully identified, and the trees or branches infested by them have been watched to learn what other species of insects, if any, have been present. The observer has even gone so far as to count the number of caterpillars upon a branch, watch the branch until it was visited by a bird, count the number of caterpillars eaten by the bird in a given time, and then count the number of caterpillars left upon the branch.

Since this work was begun thirty-eight different observers have made reports, and some of these observers have reported their observations year after year. Many of these observations have been so carefully conducted and so many corroborative reports have been received, one after another, from independent observers that there can be no doubt as to the accuracy of the conclusions reached. In fact, there is much that can be learned by such observations that can not be determined by stomach observations alone. One should supplement the other. By examining the contents of birds' stomachs, a great deal of accurate information can be gained in regard to the character of their food. Such examinations alone, however, should not be entirely depended upon, for, owing to the manner in which some birds prepare some kinds

of food for the stomach and also to the rapid digestion of the food by the bird, it is impossible in many cases to identify a large part of the stomach's contents. It is also very difficult to get by stomach examinations alone an accurate estimate as to the relative amounts of the component parts of the food taken by a species. C. J. Maynard says that food can be assimilated and digested by the cedar bird and the residue passed through the alimentary canal within half an hour. The process of digestion in the crow probably does not consume more than an hour and a half. Much of the insect food is so finely comminuted in the stomach of the bird in a few minutes that it becomes unrecognizable. Certain insect-eating birds eat only the internal parts of certain insects, casting aside the external parts, which only could be recognized by one examining the stomach of the bird. This is especially the case when the food consists of hairy caterpillars. The smaller birds eat many of the younger and smaller hairy caterpillars, swallowing them whole. It is very difficult for one depending on stomach examinations alone to recognize these soft-bodied, minute caterpillars in the stomach of the bird, where they are soon transformed into a shapeless mass. As the caterpillars become larger the birds attack them, killing them by repeated blows of the beak, tearing them open and eating out certain portions of the viscera or taking out all the body contents, rejecting the head and skin. This has often come under the writer's personal observation, and many instances are now on record where this method of feeding has been observed. Mr. F. H. Mosher records an instance where a vireo took brown-tail caterpillars, swallowing the smaller ones, pulling the larger ones to pieces, and swallowing some of the pieces. In eight minutes she destroyed 15 in this manner. Another bird of the same species was seen to destroy 73 gypsy caterpillars in forty minutes. The larvæ were large and the bird held them under its foot, pulling out certain inner parts, eating them, and discarding the rest. This is a common practice with the chickadees and tanagers. The warblers and certain other birds have the same habit. This habit is not constant, but quite general. A bird may tear one caterpillar to pieces, eating some of the pieces, swallow another whole, and take a portion of the viscera of the next.

The crows, jays, and titmice kill a great many caterpillars and pupæ which they do not eat. They are first beaten with the beak and then dropped by accident or in sport and left where they fall. Therefore we come to see the necessity of field observations to supplement dissection. He who examines the stomach contents of the birds without knowledge of the locality which the birds frequent in life and the opportunities which they have for obtaining different kinds of food, or without an insight into their feeding habits, may fall into grave errors.

Field observations will help the laboratory worker in another way. He may be enabled, by noting the feeding habits of the birds, to iden-

tify the particles of many kinds of food found in the stomach, which would be impossible of identification by one who works in the laboratory only.

The earlier observations made were valuable in so far as they showed that many species of birds were feeding on hairy caterpillars, some of them continually, others intermittently, and others attacking them only as they came in their way. But to get a definite idea of the usefulness of the different species in this respect it was necessary to count the number of caterpillars eaten by them in a given time and to note the frequency of their visits to infested trees or localities.

During this work some very interesting facts have been observed. In explanation of the large numbers eaten it should be stated that the smaller birds feed mainly on the smaller or younger caterpillars; or, when feeding on the larger caterpillars, eat only a portion of each caterpillar. They are thus enabled to do fully as good service as some of the larger species. Birds frequently visit localities infested by hairy caterpillars, most of them making short and frequent visits. Mr. Mosher was requested to time such visits and, where it was possible, count the number of caterpillars eaten during a visit.

Time and space will not allow a transcription of notes of such observations here, but an abbreviated table is given below, containing results of such observations made by Messrs. F. H. Mosher and A. H. Kirkland.

BIRDS THAT FEED ON LARVÆ OF PORTHETRIA DISPAR.

July 13. A cuckoo ate 1 every 2 minutes for 36 minutes.

July 13. A red-eyed vireo ate 73 in 40 minutes.

July 14. A yellow-billed cuckoo ate 81 in 48 minutes.

July 15. A towhee ate 7 pupæ and 2 caterpillars in a very short time (exact time not noted).

May 12. A yellow warbler ate 15 caterpillars in less than 5 minutes.

May 12. A Nashville warbler ate 42 caterpillars in one-half hour.

May 18. A scarlet tanager ate upward of 30 caterpillars within 5 minutes.

May 18. Two scarlet tanagers together ate small caterpillars at the rate of 35 a minute for 18 minutes.

May 20. A crow blackbird ate 40 caterpillars in a little over 3 minutes.

May 26. A Maryland yellow throat ate 52 caterpillars while moving in and out among trees (time could not be counted).

May 26. A redstart ate 31 caterpillars while moving about (time could not be accurately taken).

May 26. A red-eyed vireo ate, in 4 brief visits to a tree infested by *Porthetria dispar*, 37 caterpillars.

BIRDS THAT FEED ON LARVÆ OF EUPROCTIS CHRYSORRHŒA.

May 2. A robin pecked into a mass of caterpillars five times, taking a number each time. They could not be counted.

May 11. A pair of blue jays ate 47 caterpillars in 18 minutes.

May 11. A black-and-white warbler ate 15 caterpillars in 10 minutes.

May 12. A rose-breasted grosbeak ate 57 caterpillars in 20 minutes.

May 15. A chestnut-sided warbler ate 28 caterpillars in about 12 minutes.
May 16. A scarlet tanager ate 44 caterpillars in 17 minutes.
May 19. A redstart ate 11 caterpillars within 5 minutes.
May 19. Two scarlet tanagers ate, one 9 and the other 16, caterpillars in 4 minutes.
May 19. A black-and-white warbler ate 28 caterpillars within 10 minutes.
May 22. A pair of chickadees ate, one 15 and the other 21, caterpillars in 7 minutes.
May 23. A red-eyed vireo ate 43 caterpillars in 10 minutes.
May 23. A blue jay ate 30 caterpillars in a very brief stay (no time given).
May 23. A Baltimore oriole ate 34 caterpillars in 6 minutes.
May 24. A red-eyed vireo ate 29 caterpillars in 6 minutes.
May 25. A scarlet tanager ate 43 caterpillars in 12 minutes.
May 26. A yellow-throated vireo ate 14 caterpillars in less than 5 minutes.
May 26. A male indigo bird ate 16 caterpillars (time could not be accurately taken).

BIRDS THAT FEED ON LARVÆ OF CLISIOCAMPA AMERICANA.

May 9. A golden-winged warbler ate 14 caterpillars very rapidly.
May 10. A red-winged blackbird ate 22 caterpillars in 25 minutes.
May 10. A Baltimore oriole ate 14 caterpillars in 6 minutes, 27 in 8 minutes, and 10 in 3 minutes.
May 10. A robin ate 30 caterpillars in a trifle over 4 minutes.
May 10. A black-and-white warbler ate 12 caterpillars in a very short time and fed for 9 minutes, though not in plain view.
May 11. A Nashville warbler ate 8 caterpillars in 3 minutes.
May 15. A Baltimore oriole ate 15 caterpillars from a web in a very short time and 9 more 20 minutes later.

It will be noted that two scarlet tanagers ate small gipsy caterpillars at the rate of 35 a minute for eighteen minutes. Where these *dispar* larvæ are plentiful the tanagers feed much on them day after day. Should a pair of tanagers feed at the rate of 35 a minute for one hour a day, they would destroy 2,100 each day, which would be 12,600 in a week, and this number is probably not beyond the range of possibility during a week when the caterpillars are small. Should they feed for several hours a day they might even exceed this estimate. What could be expected of a bird the size of a crow can only be conjectured. As the crows, although feeding largely on hairy caterpillars, are so shy, it is difficult to obtain accurate data as to the number they eat.

It is interesting to note that most of the families of birds feeding on *dispar* are also represented in the list of those which destroy other hairy caterpillars. It is probable, therefore, that most birds which feed on one will feed on another. When one considers the disagreeable effects attributed to certain hairs of the *Euproctis chrysorrhœa*, which certainly produce a very painful irritation when applied to the human skin, it would seem that the larvæ of these insects must be quite as well protected against birds as any species, yet the evidence shows that they are eaten in quantity by as many species of birds as eat the larvæ of *dispar*.

Among those families of birds most useful in destroying hairy caterpillars in Massachusetts are the cuckoos, crows, orioles, sparrows,

tanagers, vireos, warblers, mocking thrushes, titmice, and the true thrushes, among which the robin appears to be the most useful. It has been acknowledged for years that the cuckoos form an exception to the generally accepted rule that birds do not eat hairy caterpillars. There has been no question as to the value of the cuckoos in this respect, and owing chiefly to the publications of Prof. F. E. L. Beal, of the United States Department of Agriculture, at Washington, the public has come to have a better knowledge of the value of orioles and vireos as well. The cuckoo has long been known as a caterpillar eater, because it is a large bird, feeding mainly on the larger caterpillars, and especially frequenting those outbreaks of such pests where they have done considerable injury and are, therefore, conspicuous. The cuckoo and the caterpillars both being common in the neighborhood of dwellings, the feeding habits of the birds can not escape the most casual observer. Eating, as they do, the large caterpillars, and usually swallowing them whole, there is no difficulty in determining the character of this food by stomach examination, for the heads of the caterpillars are readily recognized in the stomach, even if the skin and hairs can not be.

The observations which have been made in Massachusetts, however, leave it an open question whether other birds are not quite as useful as the cuckoos in this respect. The later observations show that crows spend much of their time in woodlands infested by hairy caterpillars, and while there are feeding on caterpillars or the pupæ almost constantly. Jays are equally industrious, and the tanagers and titmice certainly destroy vast numbers of these insects. The catbirds are also exceedingly useful, and the vireos as well. There is no question as to the value of the towhees and other sparrows which feed mainly upon the larvæ and pupæ of the moth on or near the ground and among the underbrush. Not only do these birds feed upon these insects, but they also feed quantities of them to their young. Those that do this are doubly useful, for the young birds require a tremendous amount of insect food. Mr. Mosher watched a pair of red-eyed vireos feeding their young. The young were about a day old and, being very small, could assimilate only a limited amount of nourishment, yet the old birds visited them 125 times between 7 in the morning and 5 at night, apparently bringing food each time. All the food brought appeared to be insects, which were so small they could not be positively indentified. Caterpillars form a considerable part of the food of these young birds. On June 12 Mr. Mosher watched a nest of a pair of rose-breasted grosbeaks from 6 a. m. to 5 p. m. There were 4 young in the nest nearly fledged, and the amount of food required by them was much greater than that required by the newly-hatched birds in the vireo's nest. The parents made 384 visits during the portion of the day they were watched. The food consisted mainly of caterpillars of one kind or another, and there were only 4 visits made by either bird when but

1 insect was brought. Each bird usually brought 3 or more. It has been learned that a bird will carry in this way from 3 to 11 or 12 small caterpillars in its mouth and beak at one time. The food of these young birds consisted largely of these young caterpillars, the species of which it was impossible to determine accurately on account of the distance of the nest from the ground, but many of them were certainly leaf rollers taken from the oak trees in the vicinity. It seems probable that this pair of birds and their young must have destroyed during the day at least a thousand insects, mostly caterpillars. They were watched only nine hours, and as they fed the young most of the time from daylight to dark, from twelve to fourteen hours daily must ordinarily be occupied by them in this manner.

The important economic question to be considered here is: Do birds materially affect the increase of hairy caterpillars? It is certain that many birds prefer smooth-skinned caterpillars. Many species have not been observed to eat hairy caterpillars at all, and, while this has not proved that they do not eat them, it is safe to say that such species do not habitually feed upon them. Nearly all species of birds in eastern Massachusetts feed readily upon smooth-skinned caterpillars. From the titmouse to the crow they have been observed to feed on the larvæ of *Paleacrita vernata* and *Anisopteryx pometaria*, and when these larvæ are abundant most birds seem to prefer them to the hairy caterpillars. The tent caterpillars, hatching as they do very early in the season, when the foliage first appears and the spring flights of warblers and other small birds come, form a staple food for a great number of birds. Later, as the caterpillars grow larger and the canker worms appear, they are neglected to some extent while all birds are feeding on the canker worms. The same may be said of the gipsy moth caterpillars. But if smooth-skinned larvæ are not plentiful, the hairy larvæ are subjected to the attacks of birds, and even when the food of their choice may be found in abundance, many species continue their attacks upon the hairy caterpillars, although they do not eat them in such numbers as in the other case.

Those who have studied the life history of moths have been struck with the great mortality among the younger and smaller larvæ. The writer is convinced, from the experience of the last nine years, that this is, in most cases, largely caused by birds. Several instances are known where egg clusters of the gipsy moth have hatched unmolested by man and the larvæ have disappeared; others are known where small, but flourishing, colonies have been exterminated, or nearly exterminated, mainly by the attacks of birds. Limited outbreaks of the brown-tail moth, which have been watched, have been so reduced that at the end of the season few or none could be found. What proportion of this reduction was due to parasites and other enemies of the brown-tail moth other than birds it is difficult to determine, but the observers are agreed that the most of it is due to birds. Few birds

break open the webs of the tent caterpillars. Most of the birds that feed upon it attack the young larvæ when they are out of the web. A few species, such as orioles, vireos, and cuckoos, tear open the webs, and in some cases destroy every caterpillar contained within. Some species tear open the webs, carrying parts of them away to be used as material for nesting, thus opening the way for other birds to attack and destroy the caterpillars in their nests.

The most striking instance which has come under our observation of the regulating influence exerted by birds on the increase of hairy caterpillars occurred in July, 1899, at Georgetown, Mass. Here a swarm of gipsy caterpillars had increased unnoticed, defoliating the trees, both deciduous and coniferous, and all the shrubs over a space of, perhaps, 2 acres. When the outbreak was discovered in July the caterpillars were nearly full grown and some were pupating. It was remarked at once that there were not enough larvæ to account for the injury which had been done. Many dead and dying larvæ and pupæ were found scattered about on the ground under the trees. These were examined and found to have been injured, apparently, by the beaks of birds. Small flocks of crows were constantly feeding in the grove, except when driven out by visitors, and would return immediately when the coast was clear. Vireos, chickadees, and other birds were observed feeding on the caterpillars. Mr. Mosher was detailed to watch the locality for a few days. He found that the crows, jays, tanagers, chickadees, and other birds which abounded in the vicinity were destroying thousands of the larvæ, pupæ, and imagoes. As there were very few effective parasites and other enemies of the moth noticed, the conclusion naturally arrived at was that the great reduction in the numbers of the caterpillars had been effected by the birds.

When the number of species of birds feeding on hairy caterpillars is considered, as well as the number of caterpillars eaten by each individual bird, it becomes evident that birds are an important factor in the destruction of hairy caterpillars. It would pay the farmer and fruit grower to protect and foster such species for their usefulness in this and other ways.

LIST OF BIRDS THAT FEED ON HAIRY CATERPILLARS.

The following is a list of the 46 species which, by our observations and dissection, have been proved to feed on hairy caterpillars:

Yellow-billed Cuckoo, Coccyzus americanus (Linn.).
Black-billed Cuckoo, Coccyzus erythrophthalmus (Wils.).
Hairy Woodpecker, Dryobates villosus (Linn.).
Downy Woodpecker, Dryobates pubescens (Linn.).
Yellow-bellied Sapsucker, Sphyrapicus varius (Linn.).
Flicker, Colaptes auratus (Linn.).
King Bird, Tyrannus tyrannus (Linn.).
Great-crested Flycatcher, Myiarchus crinitus (Linn.).
Phœbe, Sayornis phœbe (Lath.).
Wood Pewee, Contopus virens (Linn.).

Least Flycatcher, Empidonax minimus Baird.
Blue Jay, Cyanocitta cristata (Linn.).
Crow, Corvus americanus Aud.
Redwinged Blackbird, Agelaius phœniceus (Linn.).
Baltimore Oriole, Icterus galbula (Linn.).
Purple Grackle or Crow Blackbird, Quiscalus quiscula (Linn.).
Chipping Sparrow, Spizella socialis (Wils.).
Field Sparrow, Spizella pusilla (Wils.).
Song Sparrow, Melospiza melodia (Gmel.).
Towhee, Pipilo erythrophthalmus (Linn.).
Rose-breasted Grosbeak, Zamelodia ludoviciana (Linn.).
Indigo Bunting, Cyanospiza cyanea (Linn.).
Scarlet Tanager, Piranga erythromelas Vieill.
Red-eyed Vireo, Vireo olivaceus (Linn.).
Yellow-throated Vireo, Vireo flavifrons (Vieill.).
White-eyed Vireo, Vireo noveboracensis (Gmel.).
Black and-white Warbler, Mniotilta varia (Linn.).
Parula Warbler, Compsothlypis americana (Linn.).
Yellow Warbler, Dendroica æstiva (Gmel.)
Chestnut-sided Warbler, Dendroica pennsylvanica (Linn.).
Black-throated Green Warbler, Dendroica virens (Gmel.).
Oven Bird, Seiurus aurocapillus (Linn.).
Maryland Yellow-throated Warbler, Geothlypis trichas (Linn.).
American Redstart, Setophaga ruticilla (Linn.).
Catbird, Galeoscoptes carolinensis (Linn.).
Brown Thrasher, Harporhynchus rufus (Linn.).
House Wren, Troglodytes ædon Vieill.
White-breasted Nuthatch, Sitta carolinensis Lath.
Red-breasted Nuthatch, Sitta canadensis Linn.
Chickadee, Parus atricapillus Linn.
Wood Thrush, Hylocichla mustelina (Gmel.).
Wilson's Thrush, Hylocichla fuscescens Steph.
American Robin, Merula migratoria (Linn.).
Bluebird, Sialia sialis (Linn.).
English Sparrow, Passer domesticus (Linn.).
Cedar Waxwing, Ampelis cedrorum (Vieill.).

Mr. Marlatt, in commenting upon the great interest of this paper, pointed out the value of careful field observations. Such observations were necessary as a proper balance for laboratory work.

Mr. Felt referred to the outbreak of the forest tent caterpillar in New York during the past year, and suggested that it might be due in part to the severity of the preceding winter, which had driven South the birds that fed upon the eggs of this species.

Mr. Johnson spoke of the recent organization of the Maryland Audubon Society and the scope of its work.

Mr. Kirkland emphasized the need among entomologists of a more exact knowledge of the different species of birds. A record that a species of insect is eaten by "birds" is of but little significance; a record that a species of insect is eaten by a definite species of bird is a scientific fact of permanent value.

The following paper was next presented:

THE DESTRUCTIVE PEA LOUSE, A NEW AND IMPORTANT ECONOMIC SPECIES OF THE GENUS NECTAROPHORA.

By W. G. Johnson, *College Park, Md.*

I have to report here one of the most remarkable instances of the sudden appearance of an undescribed species of insect over a wide area, which has ever come to my notice, and which is, perhaps, one of the most unique in economic entomology. For centuries hidden in obscurity, a little green louse appears suddenly over wide areas, destructively attacking the field pea, a plant, heretofore, practically exempt from the ravages of insect foes. My attention was called to it May 18, 1899, by Mr. C. H. Pearson, one of Maryland's largest oyster, fruit, and vegetable packers, in the following communication:

One of my pea fields is entirely covered with a small green louse, which is sapping the life out of it, and if anything can be done to prevent it I want to do it at once.

I made a personal inspection of Mr. Pearson's place, containing about 1,000 acres, known locally as the "Susquehanna farm," situated along the Chesapeake Bay, in St. Mary County, at the mouth of the Patuxent River, May 24, 25, and 26. Upon my return to my office, the 27th, and after a careful consideration of the conditions and facts, I summed up the situation in a letter to my friend, Dr. L. O. Howard, United States entomologist, which I quote in part, herewith, as follows:

I have just returned from southern Maryland, where I have been making an examination of the outbreak of aphids attacking peas in that section.

I write you this statement knowing that you are interested in anything of this kind, and at the same time to give you an opportunity to see with your own eyes what I have attempted to describe below. The place can be reached within a day's ride down the Potomac, and I am satisfied you would be well repaid for the visit to see the conditions existing. At the same time we would not care to have a public announcement made at the present time, as it might militate against the owner in a way that would be unpleasant for him, as his loss is estimated now at between $20,000 and $25,000.

Without a question of doubt the destruction caused by this insect (*Nectarophora* = *Siphonophora*) is the most complete I have ever experienced. It is certainly a sad sight to look over a 100-acre field of peas and see them literally incrusted and covered with this insect. There is practically no hope to save even a fractional part of the crop in this field. It is one of desolation. As far as one can see the plants are shriveled, withered, and in many instances the leaves are blackish, looking as if a fire had gone over the surface of the ground, scorching them. The whitish cast skins of the insects stuck to the drooping leaves in the honey dew, which has been excreted by the insects everywhere over the entire field, gives one the impression that a terrible plague has surely visited that section. The attack is not confined to this particular 100 acres, but is present in adjoining fields. The owner of this estate has planted this season 1,800 bushels of peas, besides using with them 130 tons of commercial fertilizers, covering an area of 600 acres of land in all.

To say that the condition is discouraging to the owner is not necessary, in view of the fact, that at present, we are helpless so far as a practical remedy is concerned. It is safe to say that if the present weather conditions prevail very much longer, a

total destruction of, at least, 200 acres will be the result. In fact, it appears to me, after a most careful examination of the place, that the greater portion of the 600 acres is doomed to destruction within a few days, unless nature comes to our relief in the meantime. At the time of my visit yesterday the insects were flying over the fields already dead in such great swarms that it was rather uncomfortable to walk or ride through them.

The attack, however, does not seem to be confined to that one particular region, as a correspondent from a Virginia county (Westmoreland County, Mount Hague), writes the Baltimore Sun, that he has lost an entire field, sending specimens, since referred to me, which I find to be the same species. A careful and close examination of the peas in this neighborhood shows that they are infested, though not to the same serious extent. * * *

I do not know that, under the circumstances, there is any practical remedy for its suppression and control, especially when it is spread over such a wide area and in such countless numbers as it is in that section to which I have made reference. I have ordered the plowing down of 200 acres, now practically destroyed, to prevent the unnecessary spread of the insect, which land can afterwards be planted in tomatoes, providing the weather conditions warrant it. There is prevailing in southern Maryland a very serious drought, thus preventing the planting of any other vegetable at this time.

This condition is certainly unfortunate for the people, mostly colored, of that section, as many of them are dependent upon the pea crop for employment, there being on the Susquehanna farm a large cannery, fully equipped with new machinery, boxes, and a million tin cans ready to have utilized this crop of peas.

Briefly stated, this was my first introduction to the new pea pest. Further investigation showed that it was widely distributed over the State, and that serious injury would surely result to the large acreage of peas planted. The growing of peas in Maryland is a very important industry, and reliable conservative authorities place the loss this season at $3,000,000, the principal cause being the pea louse. In many cases the destruction was complete, varying from mere garden patches to hundreds of acres. The final outcome of the crop where I made my first observations was fully as disastrous as we predicted. Four-fifths of the entire area was a total loss; in other words, 480 acres out of 600 were literally sucked to death. In another instance only 110 out of 500 acres belonging to the Louis McMurray Packing Company, of Frederick County, were considered worth cutting. It is useless for me to enumerate in detail all the places I have upon my notes where the peas were not cut at all. Suffice it to say that pea growers nearly everywhere along the Atlantic coast consider that they have been visited by a veritable scourge. The attack has not been confined to Maryland alone, but I have records of its occurrence in Delaware, New Jersey, New York (Long Island), Pennsylvania, Virginia, North Carolina, and recently from Connecticut.

Talking with some of our largest growers I find the pest was present last season in considerable numbers in certain fields, and some laborers (colored) even refused to pick peas from the infested areas. Dr. Smith informs me that it was present upon late peas on the New Jersey experiment station grounds last season also.

The species responsible for this condition of affairs properly belongs to the old genus Siphonophora, but as this name is preoccupied in the Myriapoda, and is also used to denote an order of oceanic Hydrozoa, I think it eminently proper for us to recognize Mr. Oestland's name, Nectarophora, for this genus. Specimens of the insects were submitted, through Dr. Howard, to the well-known authority on the Aphidæ, Mr. Theodore Pergande, who considers it an undescribed species. Inasmuch as Mr. Pergande does not care to describe it, it is my privilege to name the insect, and I propose to call it *Nectarophora destructor*, reserving the description for another publication.

The insects attack the young vines, clustering usually at first under and within the terminals. When the leaves become overstocked the lice cluster upon the stems, quickly sapping the life out of them. It was not an uncommon sight to see a vine literally covered with the lice; indeed, whole fields of a hundred acres, as noted above.

We have found the same species on sweet peas, and have kept it for some time upon clover. In my opinion some common plant is its natural food, but as yet I have been unable to detect it.

There is little opportunity for work upon this insect from the experimental standpoint, as it is practically impossible to spray a field of peas when they are growing for commercial purposes. They are drilled in like wheat and completely cover the ground. We have shown, however, that kerosene and water can be used to good advantage upon small patches. We used kerosene from 15 to 30 per cent solution in the Deming sprayer without injuring the vines. It is not desirable to use a stronger solution than 15 per cent, but the vines will not be injured by the stronger solutions.

The latter part of June we used whale-oil soap very successfully upon late peas, at the rate of 1 pound of Good's potash-lye soap in 4 to 5 gallons of water. One of our large growers used tobacco dust, sowing it broadcast, when the dew was on, over the vines. It was very satisfactory, but hardly warranted the expense and trouble. It is exceedingly difficult to reach these insects with either a spray or dust. With our present knowledge of the creature, we must depend largely upon natural agencies for assistance. Recognizing the great importance of nature's resources for checking the multiplication of certain species, I paid particular attention to those insects and diseases that destroy plant lice. Even at the time of my first investigation on Mr. Pearson's place (May 24–26) there were enough syrphus-fly larvæ present among the lice for me to predict the destruction of most of the lice by them, if weather conditions did not intervene to bring about that desired condition, before the end of the season.

I have observed three important groups of insects feeding upon the pea louse; first, and most important, the syrphus flies; second, the lady beetles; and third, the lace-winged flies. While all of these were found in every field examined, it was interesting to note the predomi-

nation of certain species in different localities. For instance, the syrphus-fly larvæ were most numerous in the southern part and eastern shore of the State, while the lady beetles abounded in central, northern, and western Maryland.

The real importance of the syrphus-fly larvæ in the reduction of the species was shown beautifully in southern Maryland, where they were so abundant the first and second weeks in June as to almost completely destroy the lice. Their presence, however, did not save the crop of peas this season, but what their almost innumerable numbers means for the future is hard to predict, and furnishes a subject for future thought and investigation. I am now going to quote a paragraph bearing on this topic from a letter from Mr. Pearson, dated June 12, which reads like a fairy tale, but is nevertheless an undisputed fact, coming as it does from a man of undoubted veracity. He says:

> The insects (lice) started to disappear last week, and are now about all gone, but too late to be of any advantage to me this season. The last few days I packed the separators sieved out about 25 bushels of green worms, which no doubt proves that they destroyed the lice.

The "green worms" referred to were the larvæ of syrphus flies. In this connection I might state that I have bred three species of syrphus flies from larvæ found feeding upon the pea louse, all of which were kindly determined for me by Mr. D. W. Coquillett as follows: *Allograpta obliqua* Say, *Syrphus americanus* Weid., and *Sphærophoria cylindrica* Say.

The first mentioned, *Allograpta obliqua*, which we have termed the oblique syrphus, was by far the most common and important species. The greater bulk of the 25 bushels mentioned by Mr. Pearson consisted of this species. It was common all over Maryland, and was bred by me also from larvæ feeding on lice from Virginia and Connecticut. The larva is pea-green in general color, slightly streaked with white, varying in length from a quarter of an inch to a third of an inch when full grown. It pupates upon the leaves or stems of the peas, or upon some other object near by, rarely going to the ground. We have found them upon corn leaves near infested pea fields.

The next species, *Syrphus americanus*, or the American syrphus, was usually found associated with the preceding species, but not very abundant. The larva is larger than that of obliqua, brownish in color, somewhat mottled, and larger. It also pupates upon the plant or even below the surface of the ground. The adult is also much larger than obliqua, and can be distinguished from that species, even when on wing, by its bee-like hum.

The remaining species, *Sphærophoria cylindrica*, or the cylindrical syrphus, was not common, but was found in two localities associated with the others, and is much smaller than either.

Of the lady beetles four species were observed feeding upon the lice in the fields, the most important of which was *Coccinella 9-notata*.

It was most abundant in Frederick and Carroll counties. Both adults and larvæ were everywhere present in the infested fields. At the time of my visit, June 30, to the infested areas of Frederick County, I found pupæ of this species attached to leaves of peas, weeds, grass, and corn—in fact, most anything where the larvæ could secure a hold. Sometimes three or four were found upon a single leaf. The lice were on the decrease, and it was clearly seen that the lady beetles and other predaceous insects present would soon devour those remaining.

Hippodamia convergens was also quite abundant, but not so conspicuous as the preceding species. The adults of *Megilla maculata* were found in nearly every field examined, and an occasional specimen of *Coccinella sanguinea* was seen.

The larvæ and eggs of *Chrysopa oculata* Say (adult determined by Mr. Nathan Banks) were found throughout the infested districts of the State, and it has been an important factor in the reduction of the lice. The soldier beetle, *Podabrus rugosulus* Lec. (determined by Mr. E. A. Schwarz), was also observed by me feeding upon the lice in my garden near the college. This completes the list of predaceous insects observed and bred.

I was surprised, however, in not rearing any hymenopterous parasites from these lice. None appeared in any of our breeding cages, and not one was observed in the field. The only parasite bred was that of *Bassus lætorius* (♀) Fab. (determined by Mr. W. H. Ashmead), which is considered parasitic upon the Syrphus larva.

On the 18th of June I noticed a number of dead lice adhering to pea leaves in my garden, and inferred that death was due to a fungous disease. The disease continued to increase until about the 25th of June, and finally disappeared. Sometimes ten to twelve dead lice, in all stages of development, were found upon a single pea leaf. Specimens were preserved, and will be reported later by my colleague, Dr. C. O. Townsend, our State pathologist.

A few lice were found on peas in my garden throughout the greater part of the month of July. Young were being produced July 31 in a colony under observation in my study, while outside none could be found.

As to the future, candidly, I am of the opinion that it will be many a day before we will see a repetition of such destruction to the pea crop by *Nectarophora destructor*. Nature has done her work well, and there is nothing left for the economic entomologist to do other than acknowledge his inability to cope with such mysterious forces, and keep plodding along in the darkness, hoping to get a ray of light here and there as he unravels some hidden truth.

Does it not seem that old mother Nature is resenting the progress of civilization? She is calling a halt; but man, in his eagerness to gain a livelihood, is forging ahead blindly, apparently not heeding these warnings that he is going too fast.

Mr. Saunders stated that the pea louse had been severely injurious in the vicinity of the Bay of Fundy during the past year, this being, perhaps, the most northerly record of damage by the species.

The next paper was by the same author:

THE STALK WORM: A NEW ENEMY TO YOUNG TOBACCO.

By W. G. Johnson, *College Park, Md.*

When I first arrived in Maryland, in July, 1896, I was told that for some years past an insect had done a great deal of damage to young tobacco just after it was set out. From the description given me I was satisfied it was not the ordinary cutworm so common in tobacco, and could hardly believe that the injury was due to the true wireworm. I made a careful search for the creature in southern Maryland the summer of 1896, but was unable to find any trace of the culprit. In the spring of 1897 I asked my correspondents to notify me of the first appearance of the insect. It was not until June 22 of the present season, however, that I received such information as I desired. On that date Mr. E. W. Robertson, of Belalton, Charles County, wrote me as follows:

> I have 3 acres of tobacco, planted June 1, which has been killed by the stalk or wireworm, about which you desire information. I planted this field a second time the 12th, and the worms have entirely destroyed it again. I have just replowed the land, and have it ready to plant a third time, but do not know whether to do so or not, as I do not care to do all the work again if the worms are likely to kill it. I want to know about what time they leave, and if there is anything I can use to kill them without injury to the plants.

I arranged as soon as possible after the receipt of this interesting communication to make a personal inspection of the conditions. On the 27th of June I went direct to Belalton, and in company with Mr. Robertson made a critical examination of the field. We were not long in finding the depredator, and I saw for the first time the insect that had been described to me as the "stalk worm," "wire worm," "root worm," "heart worm," "bud worm," and "cut worm." I was particularly anxious to see the insect, as I knew of no record of similar injury to young tobacco in entomological literature and could not possibly identify it from descriptions given me by the planters. We had not walked 2 rods in the field when Mr. Robertson called my attention to a dwarfed plant not over one-quarter as large as those surrounding it. He said: "That plant has been injured by the stalk worm, and if you dig around it you will find the rascal that did it."

Eager to get my eyes upon the pest, I assure you I was not long in getting upon my knees, and by a few careful scrapes we found near the stalk, just beneath the surface, a small mass of silk intermingled with dirt, resembling a cobweb rolled in dust. Tearing this open I saw for the first time the stalk worm, a small, rather smooth, semitransparent, greenish larva, a little less than a half-inch in length. It was exceed-

ingly active, and crawled backward as freely as forward. I could scarcely believe my eyes when I saw it. I had fully expected to have seen a common cut worm or the true wire worm; but instead, after a hasty examination, I recognized the larva of *Crambus caliginosellus*. We obtained two larvæ from this plant and were not long in finding others near by.

This part of the field was rather rolling and a good gravelly soil. The uninjured tobacco had a leaf-spread of from 10 to 12 inches. A few rods beyond, where the soil was not so gravelly, and better, we found the larvæ had literally destroyed the first and second plantings and were at work upon the third, damaging it severely, although the ground had been replowed before the last planting. Here and there was a young plant just beginning to wilt, and invariably we found the larva at work either in the stalk or at the base of the plant just below the surface of the ground. So far as I could ascertain the attack is always at the surface or just below. In many instances the larvæ had hollowed out the stalks from the base of the roots to the branches of the first leaves. Many plants were gnawed irregularly around the stalk below the surface, and some, in fact, were completely cut off at the surface, the insect always working from below.

In the great majority of cases the larvæ were found in a small mass of web near the plant, and sometimes within it. In one plant, less than 6 inches high, we found four larvæ within the stalk, but as a rule only a single one was present.

We found no pupæ, although a diligent search was made for them. Many larvæ, from one-third to full grown, were collected. Two were found about an inch below the surface that were just beginning to pupate in cells lined with a delicate silk.

Part of this same field, containing in all about 12 acres, was planted in corn, and the same insect had totally destroyed about an acre. Only a stalk here and there was left standing in the infested area, while that surrounding was knee high. Many of the larvæ collected from the corn were a little lighter in general color than those found upon tobacco. This we would naturally expect, as the general color depends largely upon the contents of the alimentary canal, and masticated corn is lighter than tobacco.

Corn attacked by this insect, and not killed outright, is dwarfed, and generally stools at the base. Sometimes the terminal leaves are wrinkled and twisted, giving the plant an upside down appearance, as if it was trying to push the terminals in the ground. Corn is most seriously damaged by this pest when it is quite young. The larvæ attack corn very much in the same manner as tobacco, cutting and burrowing it out just below the surface of the ground.

An examination of other neighboring fields revealed the fact that the pest was present in very destructive numbers. In one field, belonging to Mr. A. W. Neale, about 22,000 plants had been destroyed by it. To

give his own words: "I have used 40,000 plants to get a stand of 18,000. They were planted three times, June 1, 12, and 26, and even now many plants are being destroyed." The land is of a fine character and will produce almost anything. It was in tobacco in 1896; in wheat 1897; in clover 1898, and tobacco again this season (1899).

This insect has been known, so far as I can find out through tobacco growers, for the last fifteen years, and possibly longer, as a destructive pest to young tobacco in southern Maryland. My conclusions from this season's observations are (1) that it is most likely to occur over local areas in tobacco following timothy or grass; (2) that the character of the soil has little or nothing to do with its ravages; (3) that the attack upon corn is also a frequent occurrence in the same section, especially when following grass or timothy.

It is difficult at present to make other than general recommendations, as there is much to be learned yet about the habits of this insect, and room for a great deal of experimental work. I am at present working upon the details of its life history. I have collected pupæ in the field in corn and tobacco June 26, 1899, July 6, 1898, and July 21, 1897, and have reared the adult moths July 2 and 10, 1898, July 24, 1899, and August 7, 12, 16, and 18, 1897. I have now 11 breeding cages established for other observations.

Experimentally, I have 8 cages under observation in which the young tobacco plants, roots and all, were first dipped in Paris green and water of various strengths, then set in 10-inch flower pots and the stalk worm established upon them. These experiments are to determine (1) the effect of strong solutions of Paris green upon the young plants; and (2) whether or not larvæ attacking plants previously dipped will not be destroyed. The results of these observations will soon be published in a bulletin from the Maryland Experiment Station.

In conclusion, at present, I would recommend (1) that growers of tobacco avoid planting upon grass or timothy sod; (2) that where grass land is plowed down it would be well to put it in wheat, following with clover, before tobacco. If desirable corn could follow the grass and the land could be seeded in crimson clover at the last working. This would serve a twofold object by revealing the exact location of the larvæ in the area under cultivation by their attack upon the corn, when they could be destroyed largely by frequent harrowing and rolling, and by affording a most excellent soil crop to turn down the following spring, which would be a decided advantage to the tobacco; that if it is found necessary to have tobacco follow grass it should be broken in the spring as early as possible, and frequently rolled and harrowed, at the same time delaying the setting of the plants as long as possible in order to destroy and starve the larvæ within the ground.

In view of these facts and past experiences of tobacco growers in southern Maryland, we can safely say that the stalk worm, *Crambus caliginosellus*, is an important economic species to be added to the list

of those affecting tobacco, and in the future it will be well for our co-workers living within the tobacco-producing area to be on their guard.

Mr. Marlatt spoke of the excellent illustrations given by these papers of sudden damage by native insects. The absence of parasites or other enemies of the pea louse was remarkable, but might perhaps be attributed to the severity of the winter of 1898–99.

Mr. Felt, in referring to the damage by the tobacco-stalk worm, inquired whether this injury was noticeable on fields that had not been in grass for some time. His experience had led him to believe that Crambids did not fly far, and if this was correct tobacco on old land should escape attack, at least in the center of the field.

Mr. Johnson stated that the field under his observation suffering the greatest harm had been in timothy and clover the preceding year and was uniformly damaged. Some years ago Mr. Beckwith had reported similar injury to tobacco in Delaware, while Mr. Howard had found the same species attacking corn in Maryland.

Mr. Osborn's observations agreed with Mr. Felt's in regard to the egg laying of Crambidæ. They are essentially grass-eating insects, and to properly understand their attacks on other crops one must trace out their habits in the surrounding fields. In a case coming under his observation a field plowed late in the spring suffered damage while similar fields plowed early escaped.

Mr. Felt thought that the eggs of Crambids were dropped at random as the females flew over the fields; hence damage by these insects follows the flight of the moths. As a rule Crambids hibernate as larvæ.

Mr. Osborn had found eggs of Crambids abundant on floors of rooms where the night previous the moths had been attracted by a light.

The following paper was then read:

AN IMPROVEMENT IN THE MANUFACTURE OF ARSENATE OF LEAD.

By A. H. Kirkland, *Malden, Mass.*

In a paper read before this Association at its meeting in August, 1897, the writer referred to a method of producing arsenate of lead by using nitrate of lead as a source of soluble lead. According to our chemist, Mr. F. J. Smith, arsenate of lead formed by this process is the diplumbic, or more exactly, a mixture of about one part triplumbic and two parts diplumbic, and not the triplumbic entirely, as is produced where arsenate of soda is neutralized with acetate of lead, as in the ordinary process of manufacture. Arsenate of lead made from the nitrate contains a slightly increased percentage of arsenic (about 5 per cent.), and as the nitrate of lead may be purchased at a less cost than

the acetate, the saving made where several tons are to be prepared is quite an item.

At the time when the diplumbic arsenate was first brought to the attention of this Association only a few experiments had been made. Since that date the insecticide has been tested in an extensive series of laboratory and field experiments, and in 1898 and again the present year in actual spraying operations in the field. A part of the results of the experiments have been published in the report of the gipsy-moth committee, January, 1898, and without presenting the mass of details from the numerous tests we may state in brief that in every case the arsenate of lead made from the nitrate has proven itself equal if not superior to that prepared from the acetate.

In preparing arsenate of lead by either process it has been found most economical to use a high grade of arsenate of soda, as the impurities, such as salt, in the lower grades neutralize a considerable part of the soluble lead before the reaction with the arsenate of soda can commence. The gipsy-moth committee obtained from a firm in England an arsenate of soda that showed on analysis 67.5 per cent of arsenic. This material costs when delivered $0.052 per pound. To make 1 ton of arsenate of lead there are required 888 pounds of this arsenate of soda at a cost of $46.18, and 2,398 pounds nitrate of lead at a cost of $161.87, the total cost being $208.05. With the same grade of arsenate of soda but using acetate of lead there are required for 1 ton of arsenate of lead 758 pounds arsenate of soda, costing $39.42, and 2,593.8 pounds acetate of lead, costing $207.50, a total cost for ingredients of $246.92. At the current prices of the ingredients this leaves a balance of $38.87 per ton in favor of the arsenate of lead made from the nitrate.

Where the proportionate amounts of arsenate of soda and acetate of lead are tied in packages in the ordinary procedure, the dampness of the acetate of lead will set up a partial reaction, and thus a part of the value of the insecticide is lost. When nitrate of lead is used there is but little of this partial reaction.

Mr. Saunders inquired as to the strength of the mixture of arsenate of lead used against the gipsy moth.

Mr. Kirkland stated that in this work the proportion was 12½ pounds to 150 gallons of water; but that from 3 to 4 pounds to 150 gallons was ample to destroy the tent caterpillar, tussock moth, and other common larvæ.

Mr. Marlatt expressed the opinion that if the total expenditure in the work against the gypsy moth had yielded no other results than the discovery of arsenate of lead and the invention of the improved spraying machinery, the money would have been well invested. Arsenate of lead was a safe insecticide to use and one of the most valuable results of the gypsy-moth work.

The next paper was presented by Mr. Forbush:

RECENT WORK AGAINST THE GIPSY MOTH.

By E. H. Forbush, *Malden, Mass.*

The attempt on the part of the State of Massachusetts to eradicate the gipsy moth has been generally considered as one of the largest problems in modern economic entomology. The conditions involve the extermination of a highly prolific, polyphagous species well established over an area of more than 200 square miles, containing within its borders the varied features of villages, cities, parks, farms, and woodlands. The unfortunate introduction of the moth in the vicinity of Boston some thirty years ago, its multiplication, spread, and fearful injury are matters of history to the members of this Association. Equally well known are the facts that vigorous attempts by individuals to free their holdings from the insect were set at naught by the inertia of indolent neighbors; that municipal control was next tested and found wanting, and that the final appeal by the sufferers to the legislature of a liberal and progessive commonwealth met with a prompt and generous response. With the close of the year 1899 the State of Massachusetts will have expended in annual appropriations for this undertaking the sum of $1,155,000. While golden opportunities for progress in this work were lost to the State through the inadequate appropriations of the earlier years, the numbers of the moth have been reduced, its spread checked, its damage reduced to a minimum, and its extermination secured in hundreds of localities and even throughout entire towns.

In protecting the property of her own citizens against this insect Massachusetts has protected the agricultural interests of the entire country. That her efforts have been fully appreciated by those most competent to judge of their character is shown by the cordial and helpful interest so often evinced by the members of this Association, without whose approval and indorsement the undertaking might ere this have been abandoned. Therefore it is with a mingled sense of gratitude and responsibility to this Association that I present a brief report of our work and its results during the first half of the present year.

The greater part of the work of the year on the gipsy moth has been crowded into the spring and summer months. In December, 1898, a large force of men was employed in cutting out undergrowth, cutting worthless trees, and preparing for the summer work. This was continued in January until the funds allotted for this month had been used.

On February 1, all grants having been exhausted, the work ceased and it was not until February 15 that an emergency appropriation of $30,000 was granted. More than $16,000 of this amount had been

used, under the law, in advance in January, leaving less than $14,000 available for use. This amount was soon expended in the continuation of the work of clearing up infested woodland. The field force was laid off until April 15, 1899, when the balance of the appropriation ($170,000) became available. Thus, although an appropriation of $200,000 was finally granted, it was only after considerable delay, and from this sum a portion not to exceed $10,000 was set aside by the legislature for work on the brown-tail moth. As in previous years the delay in making the appropriation had made it impossible to do much of the spring work. It was decided to concentrate the effort of the year on the burlapping period. Five hundred men were employed and at the height of the burlapping season this number was increased to about 570. Fifty-three tons of burlap were purchased and approximately 2,500,000 trees were burlapped, in addition to about 1,000,000 on which the burlaps of the previous year were still in serviceable condition. After the burlaps had been put on the trees and previous to the time when the caterpillars began to cluster, considerable spraying with arsenate of lead was done.

From our standpoint the weather of May and June was ideal, as hardly a drop of rain fell, and spraying under such conditions could not be otherwise than effective. In almost every case where trees were sprayed the moths were nearly if not quite all destroyed. The caterpillars matured with remarkable rapidity (although the season in the beginning appeared to be late on account of the early spring being cold and wet) and passed through all their transformations, the moths emerging at least two weeks earlier on an average than in any other year since the work began. The dry warm weather was perhaps the cause of this rapid development. A close watch was kept on the larvæ and the work of burlapping was pushed with the utmost diligence. All other work was given up, and wherever caterpillars were found the burlaps were examined as often as appeared necessary. In those localities where the greater number of larvæ were found the bands were visited once a day and even oftener in extreme cases. As a result of this work the larvæ were killed off so rapidly that few matured. As in past years more caterpillars were found in Malden, Medford, and Melrose, the central towns of the district, than in any other infested towns. It is difficult now to find egg clusters of the gypsy moth in the infested region, except in a few localities where, owing to delay in making the appropriation, the woodland has not yet been prepared for the use of burlap by cutting out the undergrowth and dead trees. This work is to be done during the fall and winter if sufficient means are provided. In some places in the central towns a great deal of burning with oil was done in June and July, while the larvæ were pupating, and there is still considerable work of this sort to be done, mainly in Malden, Medford, and Melrose.

It might be inferred from the foregoing statements that the gipsy moth in Massachusetts is nearly exterminated, but unfortunately there have been some new developments during the past summer.

In 1898 Dr. L. O. Howard recommended that warning bulletins containing information descriptive of the gipsy moth and its ravages be distributed in the towns contiguous to the infested region. This suggestion was approved and the course recommended by Dr. Howard was adopted by the committee in charge of the work. The bulletins, which were printed in 1898, have been and are still being distributed in towns adjacent to those infested. It was through the distribution of these bulletins that a moth colony was discovered in the corner of Newton most distant from what has been known as the infested region. The caterpillars were noticed in the spring by citizens who had been supplied with bulletins. The board of agriculture was notified at once of the discovery. I visited the spot immediately and found that the larvæ had already stripped a few apple trees on one estate. A little search showed that they were scattered about the country for a mile in all directions. Men were put at work there at once. Burlap was put on and attended as rapidly as possible. The number of caterpillars appeared to increase from day to day, and they finally stripped a number of trees in the neighborhood. Careful attention to the burlaps soon proved that the larvæ were scattered over an area of 3 or 4 square miles. In the worst-infested localities trees were cut, an old building which had served as a refuge for the moths was burned, and an entire pasture was burned over. Thirty men were kept at work for a month busily killing the caterpillars.

This outbreak occurred in a corner of Newton which has never been inspected, as it is beyond the limit to which, for lack of means, we have been able to extend our inspection in previous years.

A little later in the season word was received from Georgetown that caterpillars, believed to be those of the gipsy moth, were destroying the foliage of the trees in a large tract of woodland. In company with Mr. Kirkland I visited the place immediately, and found that the trees on at least 2 acres of ground on the line between Georgetown and Rowley were entirely stripped. These trees included many common woodland species, the white oak and white pine being predominant. A force of twenty men was immediately detailed here, a wide swath was cut around the infested locality, and the infested trees on several acres of ground within this belt were cut down and burned, together with the pupæ and other forms of the moth upon them. An inspection of the adjoining woodland showed that the moths had become somewhat scattered in the vicinity, and the amount of work to be done there is as yet problematical. Georgetown is at some distance from the infested region and outside of the line of previous inspections. The warning bulletins have been since distributed in Georgetown and the towns surrounding it.

A little later in the month a small colony of gipsy moths was reported from Reading. This is probably an offshoot of the colony which was suppressed there two years ago, as it is in the same locality.

None of these "finds" need of themselves cause any great apprehension, but they immediately raise the question as to how many more infested localities remain as yet unfound.

The presence of the gipsy moth in Newton is readily explained by the fact that the people on whose estate it first appeared were accustomed several years since to drive to Franklin Park, Boston, which was then considerably infested.

A resident of Melrose, living in a wooded locality which had been very badly infested, was accustomed some years since to drive to Georgetown, buying and selling poultry and pigs. He was a frequent visitor at the farm where the outbreak of this year occurred. We may not yet fully understand the significance of these two outbreaks. It seems probable, however, that these two isolated colonies, which we know must have increased very slowly at first, have been in existence for years, and that they were started when the moth had reached its most destructive height in the localities from which the seed caterpillars came. The danger of the distribution of caterpillars in this way has now been greatly lessened by the great reduction of their number. The exact condition of the infested region can only be determined by the fall inspection; but all indications now are that if the effective work of the caterpillar season can be followed up by careful inspection for eggs during the suitable weather of the fall, winter, and spring *Porthetria dispar* will be a rare insect in the infested region in the year 1900.

Mr. Marlatt spoke of the uniformly valuable results of the entomological investigations carried on under the direction of the gipsy-moth committee and felt that the improvements in spraying apparatus were of especial value.

The following paper by Mr. Burgess was read by the secretary:

A DESTRUCTIVE TAN-BARK BEETLE.

By A. F. Burgess, *Malden, Mass.*

A striking illustration of the damage that may be caused by an inconspicuous insect under favorable conditions has recently come to the writer's attention through the severe injury of hemlock bark at a Malden tannery from the attack of a small Ptinid beetle, *Dinoderus substriatus* Payk. It has been the custom of the proprietors of this establishment to carry quite a large stock of bark stored in compact piles, which are drawn upon from time to time as the needs of the tannery demand. It thus occurs that some of the piles remain practically undisturbed for many months. The present season found the firm with

a stock of over 3,000 cords of bark, purchased in Nova Scotia in 1897. On May 27 of the present year our advice was requested in regard to an unusual insect injury to the bark which was being used at that time.

The clouds of dust that arose whenever the bark was disturbed showed that the work of the insects had been pretty thoroughly accomplished. A casual examination revealed thousands of small black beetles swarming over the piles, while many times their number, together with occasional larvæ, were feeding upon the inner layers of the bark. The feeding of the insect had been practically confined to the inner bark, although many burrows extended through the corky outer layers. This, of course, made the injury far more serious, for nearly all the tannin is located in the inner bark. Mr. F. J. Smith, chemist to the gipsy-moth committee, informs me that the outer bark contains practically no tannin, while the inner bark averages from 8 to 13 per cent of tannin.

The cost of the bark delivered at the tannery was $8.50 per cord, or, in round figures, $25,000 for the entire stock. The yard employees estimated that at least one-fourth of the value of the bark had been destroyed, a figure that seemed quite conservative. If this estimate was correct, over $6,000 loss could be attributed to this little insect.

Fumigation was suggested as a means of destroying the insects, but it was not attempted by the firm on account of the expense which would be incurred for canvas and labor. The superintendent, however, commenced grinding the worst infested bark as rapidly as possible, so that on visiting the grounds July 31 it was found that all the infested piles had been utilized. In the débris remaining few living beetles were present and none were observed on examining some piles of bark that had recently come from Maine.

In connection with the habit of this beetle of feeding on tan bark, Prof. A. D. Hopkins, who kindly determined the species, remarks that "it will probably be found that this species, like a Cerambycid larva here in West Virginia, attacks the tan bark only after it is two or three years old, so that the remedy, or rather preventive, will be to avoid the accumulation of old tan bark."

Mr. Hopkins stated that this was an absolutely new record of damage by this insect to tan bark. In West Virginia similar injury to white oak had been caused by the larva of a Cerambycid. It would be of interest to analyze the dust left by these insects. If the tannin has been destroyed then they are highly injurious, but if the tannin is still present in normal amount in the dust then they might be helpful in comminuting the bark.

The paper read by Mr. Osborn, entitled "Insects of Sandusky," has been withdrawn for publication elsewhere.

Mr. Osborn presented the following report from the committee on nomination of officers:

For president, Lawrence Bruner, Lincoln, Nebr.

First vice-president, C. P. Gillette, Fort Collins, Colo.

Second vice-president, E. H. Forbush, Malden, Mass.

Secretary-treasurer, A. H. Kirkland, Malden, Mass.

On motion of Mr. Johnson, the report was accepted and the list of officers as reported declared elected.

On motion of Mr. Johnson, the fixing of the time and place of the next annual meeting was referred to the executive committee with power to act.

The committee on resolutions presented the following:

Your committee on resolutions begs leave to report as follows:

Resolved, That the Association as a body indorses and commends the work of the gipsy-moth committee, of the State of Massachusetts, in continuing the extermination of this pest. The Association also warmly indorses the quarantine work of the State Board of Horticulture of California as carried out under Mr. Craw, believing that by such efforts many foreign insect pests can be prevented from becoming established in this country. The Association is also in full sympathy with judicious national and State legislation for the purpose of enacting and enforcing laws to prevent the importation of foreign insect pests, and controlling or exterminating such as have become already established in this country.

Resolved, That we request the honorable Secretary of Agriculture to publish the proceedings of this meeting, and that we express to him our hearty appreciation of such action in previous years.

Resolved, That we express our thanks to the Ohio State University, its officers, and the local committee, for courtesies extended the Association.

Resolved, That we express our high appreciation of the efforts of the president and secretary in making this such a successful meeting.

L. O. Howard,
Herbert Osborn,
E. P. Felt,
Committee.

On motion of Mr. Hopkins, the resolutions were adopted.

On motion of Mr. Osborn, it was voted to dispense with the reading of the minutes of the meeting.

On motion of Mr. Osborn, it was voted that the secretary be instructed to send to the several members for revision a copy of their remarks on the principal subjects under discussion at the meeting.

Adjourned.

A. H. Kirkland,
Secretary.

LIST OF THE MEMBERS OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

ACTIVE MEMBERS.

Adams, M. F., Buffalo, N. Y.
Aldrich, J. M., Moscow, Idaho.
Alwood, William B., Blacksburg, Va.
Ashmead, William H., Washington, D. C.
Baker, C. F., St. Croix Falls, Wis.
Ball, E. D., Ames, Iowa.
Banks, C. S., Albany, N. Y.
Banks, Nathan, Washington, D. C.
Barrows, W. B., Agricultural College, Mich.
Beckwith, M. H., Elmira, N. Y.
Bethune, C. J. S., London, Ontario.
Bogue, E. E., Stillwater, Okla.
Britton, W. E., New Haven, Conn.
Bruner, Lawrence, Lincoln, Nebr.
Bullard, W. S., Bridgeport, Conn.
Burgess, Albert F., Malden, Mass.
Campbell, J. P., Athens, Ga.
Chambliss, C. E., Knoxville, Tenn.
Chittenden, F. H., Washington, D. C.
Cockerell, T. D. A., Mesilla Park, N. Mex.
Collins, Lewis, Brooklyn, N. Y.
Comstock, J. H., Ithaca, N. Y.
Cook, A. J., Claremont, Cal.
Cooley, R. A., Bozeman, Mont.
Coquillett, D. W., Washington, D. C.
Cordley, A. B., Corvallis, Oreg.
Davis, G. C., Los Angeles, Cal.
Doran, E. W., Clinton, Mo.
Ehrhorn, E. M., Mountainview, Cal.
Felt, Ephraim P., Albany, N. Y.
Fernald, C. H., Amherst, Mass.
Fernald, H. T., Amherst, Mass.
Fiske, W. F., Durham, N. H.
Fletcher, James, Ottawa, Canada.
Forbes, S. A., Urbana, Ill.
Forbush, E. H., Malden, Mass.
Frost, H. L., Boston, Mass.
Garman, H., Lexington, Ky.
Gibson, Arthur, Ottawa, Canada.
Gifford, John, Mays Landing, N. J.
Gillette, C. P., Fort Collins, Colo.
Goding, F. W., Newcastle, New South Wales.
Gossard, H. A., Lake City, Fla.
Gould, H. P., College Park, Md.
Hargitt, C. W., Syracuse, N. Y.
Harrington, W. H., Ottawa, Canada.
Hart, C. A., Urbana, Ill.
Harvey, F. L., Orono, Me.
Hillman, F. H., Reno, Nev.
Hine, J. S., Columbus, Ohio.
Hopkins, A. D., Morgantown, W. Va.
Howard, L. O., Washington, D. C.
Hudson, G. H., Plattsburg, N. Y.
Hulst, G. D., Brooklyn, N. Y.
Hunter, S. J., Lawrence, Kans.
Johnson, W. G., College Park, Md.
King, George B., Lawrence, Mass.
Kirkland, A. H., Malden, Mass.
Lowe, V. H., Geneva, N. Y.
Lugger, Otto, St. Anthony Park, Minn.
McCarthy, Gerald, Chicago, Ill.
Mally, C. W., Wooster, Ohio.
Mann, B. P., Washington, D. C.
Marlatt, C. L., Washington, D. C.
Morgan, H. A., Baton Rouge, La.
Mosher, F. H., Malden, Mass.
Murtfeldt, Miss M. E., Kirkwood, Mo.
Niswander, F. J., Cheyenne, Wyo.
Osborn, Herbert, Columbus, Ohio.
Packard, A. S., Providence, R. I.
Palmer, R. M., Victoria, British Columbia.
Pergande, Th., Washington, D. C.
Perkins, G. H., Burlington, Vt.
Pettit, R. H., Agricultural College, Mich.
Phillips, J. L., Blacksburg, Va.
Popenoe, E. A., Topeka, Kans.
Quaintance, A. L., Experiment, Ga.
Rane, F. W., Durham, N. H.
Reed, E. B., Esquimalt, British Columbia.
Rolfs, P. H., Clemson College, S. C.
Rumsey, W. E., Morgantown, W. Va.
Sanderson, E. Dwight, Newark, Del.
Saunders, William, London, Ontario.
Schwarz, E. A., Washington, D. C.
Scott, W. M., Atlanta, Ga.
Sherman, Franklin, jr., Ithaca, N. Y.
Sirrine, F. A., Jamaica, N. Y.
Slingerland, M. V., Ithaca, N. Y.
Smith, J. B., New Brunswick, N. J.
Snow, F. H., Lawrence, Kans.
Southwick, E. B., New York, N. Y.
Stedman, J. M., Columbia, Mo.
Stimson, James, Watsonville, Cal.
Summers, H. E., Ames, Iowa.
Test, F. C., Chicago, Ill.
Thaxter, Roland, Cambridge, Mass.
Toumey, J. W., Tucson, Ariz.
Townsend, C. H. T., Mesilla Park, N. Mex.
Washburn, F. L., Eugene, Oreg.
Webster, F. M., Wooster, Ohio.
Weed, C. M., Durham, N. H.
Weed, H. E., Griffin, Ga.
Wilcox, E. V., Washington, D. C.
Woodworth, C. W., Berkeley, Cal.

FOREIGN MEMBERS.

Barlow, Edw., Calcutta, India.
Berlese, Dr. Antonio, R. Scuola Superiore di Agricoltura, Portici, Italy.
Bos, Dr. J. Ritzema, Amsterdam, Netherlands.
Carpenter, Prof. George H., Science and Art Museum, Dublin, Ireland.
Cholodkowsky, Prof. Dr. N., Institut Forestier, St. Petersburg, Russia.
Cotes, E. C., 201 Iffley road, Oxford, England.
Danysz, J., Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
Enock, Fred., 13 Tufnell Park road, Holloway, London, England.
French, Charles, Melbourne, Australia.
Froggatt, W. W., Sydney, New South Wales.
Fuller, Claude, Department of Agriculture, Cape Town, South Africa.
Giard, A., 14 rue Stanislaus, Paris, France.
Grasby, W. C., Grenfell street, Adelaide, South Australia.
Green, E. E., Pundaluoya, Ceylon.
Helm, Richard, Perth, West Australia.
Horvath, Dr. G., Musée Nationale Hongroise, Budapest, Hungary.
Lampa, Prof. Sven, Statens Entomologiska Anstalt, Albano, Stockholm, Sweden.
Lea, A. M., Hobart, Tasmania.
Lindeman, Dr. K., Landwirthschaftliche Akademie, Moscow, Russia.
Lounsbury, Charles P., Department of Agriculture, Cape Town, South Africa.
Marchal, Dr. Paul, 16 rue Claude Bernard, Paris, France.
Musson, Charles T., Hawkesbury Agricultural College, Richmond, New South Wales.
Ormerod, Miss Eleanor A., Torrington House, St. Albans, England.
Porchinski, Prof. A., Ministère de l'Agriculture, St. Petersburg, Russia.
Reed, E. C., Rancagua, Chile.
Reuter, Dr. Enzio, Fredriksgatan 45, Helsingfors, Finland, Russia.
Schöyen, Prof. W. M., Christiania, Norway.
Shipley, Prof. Arthur E., Cambridge, England.
Targioni-Tozzetti, Prof. A., R. Staz. d. Entom. Agrar., Florence, Italy.
Tepper, J. G. O., Adelaide, South Australia.
Theobald, Frederick B., Wyecourt, County Kent, England.
Thompson, Rev. Edward H., Franklin, Tasmania.
Tryon, H., Brisbane, Queensland, Australia.
Urich, F. W., Victoria Institute, Port of Spain, Trindad, West Indies.
Vermorel, V., Villefranche, Rhône, France.
Whitehead, Charles, Barming House, Maidstone, Kent, England.